the saw spindle by grooves and feathers. They are made of thin steel plates screwed between two metal plates, which are worked down on each side so as to leave the steel edge projecting about $\frac{1}{20}$ of an inch.

Seventhly, a machine for preparing deals and baulks of timber for sawing. The wood to be operated upon is laid on a metal bed moved by a rack and pinion and slides on V pieces fixed to the floor. The apparatus for holding the timber is firmly secured to this bed; puppets are screwed to the sliding bed, their inner faces being made perfectly true. To these faces a cast-iron beam is attached vertically, so that it can be moved up and down, by nuts and screws, and serves to clip the upper part of the piece of timber.

The holding parts are capable of adjustment, so that timbers of any size may be held on different sides quite firmly, and brought up to the cutters by the traversing bed, for preparing a flat or square side thereto.

Eighthly, a machine for the same purpose, which may also be used for cutting mouldings or cornices and skirting-boards.

The wood in this case is secured to a traversing table and moved forward by a chain, rack and pinion, or other convenient means. Circular cutters are made to revolve above it, which strike the required pattern on the edge of the wood as it advances.

Ninthly, another machine for the same purpose, only in this case the machinery with the cutters approaches the wood instead of the wood approaching the cutters. This consists of a moveable bed traversing upon a fixed one; this bed carries the cutters with their driving wheels, &c. The wood is held upon a rising and falling table, while the machinery, cutters, &c. on the traversing bed are made to approach and perform the required operations on its surface and edges.—*Ibid.*

MACHINERY FOR PRODUCING PLAIN OR MOULDED SURFACES ON WOOD.

James Hodgson, of Liverpool, Engineer, for a new mode of combining and applying machinery for the purpose of cutting and planing wood, so as to produce plain or moulded surfaces. Enrolment-office, Feb. 3, 1841.

This invention consists in a mode of combining and applying machinery, whereby the patentee is enabled to employ a rotary spiral cutter for cutting and planing wood, so as to produce either plain or moulded surfaces. The machinery consists of a strong cast-iron frame, of any required dimensions, planed perfectly true on its upper edges, the feet or standards being bolted down to the flooring so as to give great firmness and stability. A cast iron table, also planed perfectly true, slides smoothly and equally upon the bed; this table is fitted with a cover or plate of wood on its upper surface, for the convenience of affixing thereto the wood to be operated upon by the machine.

Nearly in the middle of the bed there rises an upright frame or slide, in which the revolving spiral cutter is supported, and raised or lowered by a screw. The spiral cutter consists of a twisted bar of steel, or of iron and steel combined, the cutting edge passing from one end to the other in a spiral direction around the axis of its motion. This cutter is driven at a great speed, and revolves transversely to the grain of the wood. Such a cutter is adapted for the production of plain surfaces only; if mouldings are to be produced, the cutter must be worked out to the pattern intended to be given to the moulding. One mode of effecting this is stated to be by making a steel tool of the pattern required, which is placed beneath the spiral cutter while in rapid motion and gently raised as the cutter becomes indented. The edges of the pattern thus produced, are then filled up to an angle and sharpened, so as to make a clean cut in the wood moulding. The motion is supplied from a steam engine or other prime mover to a fast or loose pulley, from whence a series of wheels and bands communicate the necessary high velocity to the spiral cutter. The table on which the wood is fixed to be cut slides backward and forward upon the bed; a rack placed on its under side is acted upon by a pinion, driven by suitable traversing gear, and carried forward to the cutter. The backward movement is accomplished by a small handle on the axis of the pinion.

The claim is for the mode described, of combining and applying machinery so as to employ a spiral rotory cutter for cutting and planing wood so as to produce plain or moulded surfaces.—*Ibid.*

IMPROVEMENTS IN ROOFING AND SLATING BUILDINGS.

James Taaffe, of Shaw-street, Dublin, Slater and Builder, for improvements in roofing and slating houses and other buildings. Enrolment-office, Feb. 1, 1841.

These improvements consist of a novel mode of roofing and slating houses and other buildings, whereby much of the overlapping of the slates will be avoided, and roofs will be more advantageously formed and constructed with a much smaller quantity of timber and slates than at present used. And a roof formed according to the tenor of this patent, will, it is said, be much superior to that which could have been produced by a larger quantity of timber and slate applied as hitherto practised. In the first place, the rafters have a groove ploughed or otherwise made in their upper surface which is to be lined with lead, zinc, or other suitable metal to form water channels or courses. Two other modes of forming these water courses are shown: in the one case the rafter is divided into two and an angular metal gutter placed between; the other is formed by nailing two projecting strips of wood along the sides of the rafter, which form the sides of the channel. The rafters being furnished with proper water channels in some of these, or other convenient ways, slates are taken of such a width as to reach exactly from the centre of one water course to the centre of the next, so that the side joinings of each series of slate fall exactly over the centre of the water channels, by which means any water that may pass through between them, is carried off into proper gutters. The first or lowest row of slates are screwed to the rafters by four copper screws, one in each corner, but in all the other rows, two screws, at the upper corners, only are used. Nails may be used instead of screws for fastening the slates to the roof, but the latter are preferred.

Where the slates overlap each other they are held together by clamps of this form, ⌶, made of copper or zinc. A notch is cut in the sides of the two upper slates, and a space cleared away in the two lower ones to admit the stem of the clamp. On the under side of the slates where they overlap, two throats or grooves are cut to prevent the water from running along underneath and so getting beyond the water channels.—*Ibid.*

COKE OVENS.

John Cox, of Ironmonger-lane, civil engineer, for improvements in the construction of ovens for the manufacture of coke, and other purposes. Jan. 19.—The oven is constructed of any convenient form, and of suitable materials. The best Stourbridge fire-bricks, with the joints closed by the same clay of which the fire-bricks have been made, is preferred. The roof of the oven is to be made very thin, and a broad flat shallow flue formed over it. The oven is charged in the usual manner, and the door closed, and as the gaseous products arise they are conveyed through proper small apertures into the flue above, where they are supplied with a sufficient quantity of atmospheric air to support combustion. They are consumed in the flue, and the heat transmitted downwards, for the purpose of promoting the process of coking through the roof of the oven. In some cases only part of the distilled products is consumed for the purpose of coking, and the remainder carried away in any convenient manner for any other purpose for which it may be required. In other cases the atmospheric air is admitted into the chamber with the coal, and thereby the products are consumed together with the coal. Sometimes retorts or other small vessels to be heated are set in the flue above the roof of the oven, and the products consumed as at first described.—The inventor does not claim the mode of consuming the distilled products in the same chamber as the coal; nor the application of flues to the bottom, sides, or ends of the oven; but he claims—First, The creation of heat by the admission of atmospheric air to the distilled products in or after they have left the oven, and the consequent combustion of the said products in or after they have left the oven.—Second, The same, whether the air be admitted at the top, bottom, sides, or ends of the oven.—Third, The same, whether the heat be employed for the process of coking only, or for manufacturing or other purposes as well.—Fourth, The promoting the process of coking by the application of a flue or flues over the top of the oven; whatever be the form or construction thereof.—*Inventors' Advocate.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

KING'S COLLEGE.

MR. HOSKING'S LECTURE.

We are glad to see that the Class of Engineering and Architecture is being carried on under such good auspices; our readers will see, by the following sketch, the course that Mr. Hosking proposes to adopt in the important department of instruction which falls under his direction. In expressing our approbation of the general views propounded by Mr. Hosking, we have to thank him and his colleagues at the College for their courtesy to us on this and so many other occasions.

After some introductory observations Mr. Hosking proceeded as follows:

"The printed paper already in your hands gives a general statement of the matters to which I shall have to direct the attention of the student, and I believe that every man who has had to learn these things for himself will readily admit that any instruction in them, however imperfect it may be, may become of the greatest practical value, by supplying, as a ground work for professional study, what has had, but too often, to be learnt in practice, and what, oftener still, is never learnt at all.

"We cannot hope here to make young men carpenters or masons, but we hope to make them better qualified to compose, describe, estimate and direct works of carpentry and masonry than they can be without such assistance as that we offer them. In becoming proficient as a carpenter, a mason, or a smith, a young man is apt to overlook the importance of other handicrafts in favour of that in which he has acquired confidence,—but a sound, and indeed a somewhat extensive practical knowledge of the modes of operating in all the leading crafts, of which the three I have mentioned, together with the bricklayer's craft, are the most prominent, is essential to the civil engineer, who only exists independently of the architect on the one hand, and of the practical machinist on the other, through his presumed superior practical skill in applying the operations of the carpenter, mason, bricklayer and smith, in connection with those of the navigator or earthworker and miner." The early life and experience of the late Mr. Telford are next referred to, with an account of his occupation in youth, and of his estimate of the value of such occupation to the intending engineer. Mr. Hosking then remarks:

"Such was the early education, and such were the matured opinions of the

man who has left hardly a corner of our island without some important work to record his name.". . . . . "But Mr. Telford goes on, from the observations I have already quoted, to state thereupon his opinions and practice with regard to the education of the civil engineer: 'My readers,' he says, 'may *not* dissent from these observations, but few of them, unless practical men, will feel their full force. Youths of respectability and competent education, who contemplate civil engineering as a profession, are seldom aware how far they ought to descend in order to found the basis of future elevation. It has happened to me more than once, when taking opportunities of being useful to a young man of merit, that I have experienced opposition in taking him from his books and drawings, and placing a mallet and chisel, or a trowel in his hands, till, rendered confident by the solid knowledge which only experience can bestow, he was qualified to insist on the due performance of workmanship, and to judge of merit in the lower as well as the higher departments of a profession in which no kind or degree of practical knowledge is superfluous. *For this reason I ever congratulate myself upon the circumstances which compelled me to begin by working with my own hands.*'

"You will find indeed that not Telford alone, but that most of the men who responded to the demand that arose in the middle of the last century, for professional aid in the formation and construction of that class of works now distinguished as works of civil engineering, in default of skill and capacity on the part of the architects of the day, were men whose early education was that of the workshop;—they were *masons, miners*, and *millwrights*. Whilst the practical knowledge of Telford and Rennie—the mason and the millwright—exists in its effects upon those who had the advantage of working with and under those eminent hydraulic architects, the practice of civil engineering as at present constituted will continue,—but those who seek to engage in and follow it must qualify themselves by direct application to the sources from which it sprung, and upon which alone it can rest a continued existence. The man of science may be formed independently of the workshop—but it is through the workshop alone that the man of science can become what the men I have enumerated were; he may possess himself, in the office, and in the service as an assistant, of the established practitioner of the routine of business,—of the habit of using technical terms,—of repeating working and other drawings, and of using set phrases and forms in the composition of a specification;—he may learn to estimate and to describe the items of an estimate as they are usually described, and to attach prices to the items according to the established usage;—and having made these acquisitions he may consider himself fitted to practice as a civil engineer. He will feel himself competent to investigate any question that can arise in practice when the *data* are supplied,—but he will find that questions continually arise upon which no data are to be obtained; he will readily undertake to lay out and design any class of work within the range of engineering practice, but he will learn from the contractors as the work proceeds, that this cannot be done as he may appear to have intended,—that that will not do in this particular case, that such and such things are unnecessary, and such others essential, and when the works are completed he will have the mortification of finding that the variations made, and the alterations and additions effected have made his contract a dead letter. . . . There are other cases, however, and they are already too frequent, in which conscious incompetence determines to be on the safe side, be the cost what it may, and works are overloaded with materials that they may be strong enough;—and thus again the employer is defrauded, for fraud it is if a man undertake a duty which he is not thoroughly qualified to perform."

Mr. Hosking then proceeded nearly as follows, giving an etymology of the designation of engineer, which has the appearance of novelty, and entering into details which we have not space to include in our mere abstract:—

"It may not be devoid of interest, and it may help to give a distinct perception of what the practice of civil engineering includes, if I trace the circumstances out of which it grew. Many of the works and operations now included in the practice of the civil engineer are of late origin themselves, and a large proportion of them were formerly within the practice of architecture, and was known, when distinguished at all, as hydraulic architecture. Modern fortifications, or fortifications having reference to ordnance, consist in a great degree of earthworks, and through the practice of forming them the different corps of military engineers became skilful in the disposition and working of earth,—in draining for the exclusion, and in forming conduits and sluices for the admission of water. As the advance of modern civilization required operations similar to those practised by the military engineers for protecting lands from rivers, and from the sea, by embankments,—for draining low lands,—for supplying towns, and for feeding canals with water, the peculiar designation of the military engineer and operator was adopted by the civil practitioner, who thus became what is known as the civil engineer. Throughout the continent of Europe the services of the architect had been still in requisition in aid of the military engineer, in directing the constructions for which he had occasion, and we thus find some of the finest works of many of the Italian architects from the 13th and 14th centuries down to the present time, on the gates of fortified places. In England, however, almost ever since the introduction of gunpowder, the fortification of towns and cities, fortunately, has not been necessary, and the British architect has had therefore no practice in connection with the military engineer. Hence, the almost total deficiency of architects in this country in hydraulic constructions, so that when a demand arose for works which imposed such constructions in connection with earthwork formations, the millwrights and masons, who had built the flood-gates and sluices with their wing and head walls, and had learnt to direct the formation of the earthworks from the Dutch embankers and drainers, were called upon to undertake them, and thus the hydraulic architect is found in conjunction with the formator or embanker and drainer, who brought to the profession thus compounded the designation of civil engineer.

"The practice of civil engineering and architecture is, therefore, strictly, the complete practice of architecture in its most extended sense; that of the former may be said to include formations and constructions influenced by, in connection with, or affected by, that powerful agent—water,—whilst, the separate practice of architecture is generally restricted to constructions not so exposed, and to constructions susceptible of, and subject to decoration. The architect who builds sewers and drains,—and it is within the practice of all architects to do so,—is in so far a civil engineer,—whilst the engineer who builds a bridge, or a viaduct, is in so far an architect, for although, according to the general definition that I have given, the founding of piers and abutments to a bridge over a river, or other water, would fall within the province of the engineer, the main constructions of a bridge, especially when of masonry, are within that of the architect."

"Roads as now made, and railways, are late additions to the practice of the civil engineer. Roads brought bridges with them, and railways have brought many other varieties of construction that can hardly be called hydraulic, for although their frequent connection with earthwork exposes them for the most part to the action of water, they are generally so situated as to demand the architectural dispositions which may be classed under the head of decoration. To be an accomplished civil engineer a man must, therefore, be a good architect in the ordinary acceptation of that term, as well as skilled in the sciences and arts of construction, far above what architects commonly are. Together with formations and hydraulic constructions the practice of civil engineering includes the application of machinery in the aid of commerce and of the useful arts. Hence, and because of the name applied to some of his productions, the manufacturer of engines and machinery, the mere machinist has been called an engineer. A machinist may certainly become a civil engineer, but the power of making a locomotive engine does not seem to form a better qualification for railway engineering, than that of carriage building does to constitute the builder an efficient roadmaker;—it is not the cannon-founder who is entrusted with the construction of fortified places and field works, but the engineer officer whose education and practice have fitted him for this more important service."

"In promising information and instruction that will be useful to you in the pursuit of your professions respectively, I must beg to be understood not to promise to qualify you here to practice as architects or as civil engineers. We offer you information whereby you may become qualified to avail yourselves more effectually of the practice of the engineer's or architect's office, and thereby to become *better* architects and *better* engineers, to your own confidence, comfort, and advantage, and for the advantage of society to whom your services will be hereafter offered, than you would have been without such instructions and information as we offer. The medical student comes here versed in pharmacy, and in the simpler surgical operations, and he finds his field of study and practice complete between the lecture and dissecting rooms of the college, and the wards and the operating theatre of the hospital, but to you, who come to us unskilled in carpentry and masonry, the pharmacy and surgery of your professions—we have the deficiency to supply, as well as to teach the science which those humbler arts aid you in applying, but *your* hospital must be walked in mud boots, and your operating theatre found on the stage of the carpenter, and on the scaffold of the mason and bricklayer. The young sailor may and should learn navigation on shore, and how to rig a ship and to reef and steer in harbour, but he must go to sea to become a sailor,—and the young architect or engineer, may and should, in like manner, acquire the theory, and learn, as far as may be, the practical arts of his intended profession, in a preliminary education, but he must place himself with the active practioner through whom he may have facilities for seeing works in progress, and opportunities of assisting to forward them, together with the means of acquiring the technicalities of practice, to become an efficient practitioner of architecture and engineering himself.

But why, I may be asked, if the practice of an office and the observation of actual works is essential after you have expended time and money here, why not go from school or college at once to a practical office? I answer, that without such preliminary education in science and the arts as that offered you here, the practice of an office will be in a great degree lost upon you; you may learn by rote but you will not know the meaning of the words—you may have opportunities of seeing works, but "seeing you will not see, and hearing you will not understand;" the characters may be clear, and the meaning of the words obvious, but to you they will be unknown, and therefore unintelligible.

I would say, then, acquire superiority over the merely practical man—the rule of thumb engineer by the attainment of sound scientific knowledge, in addition to the mere practical skill with which he tenders his services;—but do not depend upon scientific knowledge alone, if you propose to become civil engineers, and hope to gain your bread by the practice of civil engineering as a profession, for it may be truly said, paraphrasing the beautiful language of an inspired writer, you may have all learning and all science, but if you want this practical knowledge of which I speak, you will be but "as sounding brass or a tinkling cymbal."

SCHOOL OF DESIGN, LEICESTER SQUARE.

On Monday the 15th ult., a lecture on the application of perspective, being part of a course, was delivered by George Foggo, Esq., at the School of the Society for Promoting Practical Design, Saville House, Leicester Square, before a numerous and respectable audience of members of the society, artists, students, &c.

The lecturer commenced by urging the necessity of a knowledge of perspective in ornamental design; observing that however the students in that class might be inclined to undervalue such an acquirement, they could not nor did not make a drawing without availing themselves of it. So accustomed are we to see objects in perspective, that we are perpetually putting objects in perspective without being aware of it. The child newly born is destitute of this knowledge, but we cannot pass through life without acquiring it—we must perforce obtain a knowledge of the distance of objects, their relative positions, their size, their colour. There is not a human being who does not learn this—not an animal—we could not go through life without it. Whether in historical composition, or whether in architectural design, we are obliged to have recourse to perspective. The architect, after making his design, may think he has nothing to do with this science, but if he do not attend to it, he will soon find himself in serious difficulties. Suppose, for instance, he has designed a frieze; although it may look very well upon paper, yet, when it comes to be placed high up, and lighted in a particular way, he may find the effect very different from what he intended. From want of knowledge of this kind, lamentable errors occur; in buildings recently erected, ornaments are lighted with windows in such a way as to lose their effects; a delicate scroll is placed at such a distance as not to be seen, and bold ornaments brought too near. I am anxious, said the lecturer, that in drawing ornament we should not draw it as if it were a mere dead inanimate object, but should remember that taste is required for designing pure ornament. This may not suit those who are contented with copying, and think that they have done enough when they have reproduced a design from the French, or the German, or the Italian, or the Greek; but it is the right course—copying we always find limited, nature ever varying. We have heard much lately about copyright of all kinds, but I think a great deal more has been said than has been necessary; I am by no means disposed to admit that copyright can be derived from the mere act of copying the design of another, whether that design be French or Greek, one year old or a thousand. Copyright should have no right for merely copying others, but for original adaptations of natural objects. Composition requires originality and power of mind, without which the name is idle. The architect has irregular materials to bring into regular proportions; the designer of artistical compositions has the opposite course, to take fixed objects, and to place them in every allowable variety of attitude that is to be found in nature. Some imagine that great diversity of power is required for these two objects, that it takes very little power to make an architectural design, and much to produce a picture. I am not inclined, however, to allow this. Want of reference to nature is, in my opinion, the principal defect of our architects, the result of which is the greatest inconsistency. Thus, if we want a church, the architect will, without regard to propriety, take a Greek temple for his model, and so in an edifice where no sacrifice is allowed, devoted to a religion by which it is abolished, we shall find the sacrificial ornaments of another creed. If we are to have a theatre, the same temple is referred to, and then we get the sacrificial emblems again. There is no thought of propriety, though a building should be appropriate in its character to the object to which it is devoted, and mark the circumstances which have influenced its erection.

The architect having to do principally with straight lines in composition, has of necessity much difficulty to contend with, but he has other and greater difficulties; the want of having men of taste to judge of his productions causes inactivity on the part of the architect, and the result is that he contents himself with making a flaming copy from some antique building of reputation, which pleases the committee because it saves them the trouble of judging. His rival, with less knowledge of the world, labours hard to produce a good plan and an original elevation; his plan is never looked at, because it is not understood, and his elevation being placed by the side of those of his competitors, is outstared by them, and so he is discarded. By and bye the favoured design is carried into execution, and then, to the general disappointment, it is quite inapplicable. (The lecturer here proceeded to sketch the ground plan of a building, and show the modifications which would be required in the external effect by different arrangements of the interior.) When an architect has got over the impediments thrown in his way by the ground plan, he will, without a knowledge of perspective, find himself in serious difficulties in making his elevation. There will be a want of important parts, broken lines, intricacies in the external arrangements, so that the eye can never repose satisfactorily. Still a good plan is a great thing, and it is of much importance that the public should know what plans are, for every one may now be on a committee some day, and it is very essential that this point should be understood. The elevation may mislead, while the plan is the first thing, and when we have provided for the useful, we can afterwards see what sort of a fine frontage can be applied. Some of the cabinet-makers and upholsterers studying here must very frequently be applied to with regard to furniture, when they first send in a drawing of what is imperatively necessary, and then do what they can to ornament it afterwards. Sometimes, however, the contrary occurs; a pretty drawing is made, and when the article comes to be put up, it is found clumsy and useless. Nor do I hold that it requires much less talent to design furniture properly than to design a building—and, indeed, in many of our recently erected club-houses, the architects have themselves designed the furniture, plate, &c. Unfortunately, however, architects have little studied this department, and if they attempt it, there is a baldness in their works far from pleasing.

Architects have not often, more particularly in crowded cities, the choice of situation, but still it is in their own power to do something more than they do. There was, for instance, no necessity in Pall Mall to swamp the Travellers' Club by rearing next to it the Reform; had this been done by others, Barry would most probably have been offended, but people are not so offended at their own deeds as at those of their neighbours. Here, however, the example is given, and so, perhaps, some day we may have another larger, and the Reform Club itself overshadowed. The back of the Traveller's Club is not the less admirable, and it is much to be regretted that the architect had not combined the two buildings in one design. It is, in fact, a duty of architects to avail themselves of the position in which their building is to be placed; if, for instance, the space were next to a church, then, by making the new buildings, though not uniform, yet in some degree, correspond with those on the other side, the church might be brought into the composition, and so a better effect produced. Regular composition in architecture requires a centre and two wings; so if we see a bridge with four arches, the effect is unpleasant, though this is sometimes avoided by making the piers more prominent, but this again leads to another impropriety. The bridge, to be effective, must have three or five arches. The building, too, requires good thick flanks; this Wilkins forgot, and thus, in the National Gallery, we have the flanks getting thinner and thinner till they come to almost nothing. Solidity of effect is a thing imperative—the human mind requires bulk—it does not consider surface sufficient; if we see a surface, we like to know what is behind it, and particularly with regard to stone, for we always imagine the other front must be something similar. I may be reminded that, in the Gothic, there are exceptions and most beautiful ones, but these are exceptions only as between the uninstructed and the instructed—the instructed will see where strength is, and so be better satisfied with the effect produced. It is our duty to make our building as vast as possible with the materials we possess; if we do something great with small materials, money is saved; if great materials are frittered away in petty details, we have spent a vast deal to produce a little effect. It may be thought much better not done at all, unless the effect be produced at little expense. Two instances have been greatly extolled by our travellers; St. Peter's, at Rome, say they, is so vast and so beautifully proportioned, that we do not perceive its grandeur, and it is only when we come to examine some of the parts, that at last we are convinced. Another instance is the column in the Place Vendôme, at Paris, which is made after a barbarous Roman model—a column in Grecian proportion, is covered with a thick coat of bronze, and made gouty, just like the Duke of York's column in the Park. If the Napoleon column appears 80 feet high instead of 150, it certainly appears to me much better to have spent *half* the money to have produced a column which should have appeared 150 feet high. It is travellers only who see things of this kind, who stand openmouthed with astonishment that much money should be thrown away to produce nothing.

Architects very frequently complain of want of money, but with injustice, for it is by no means the amount of money, nor the vastness of the material at their disposal, on which the affair depends, particularly if money be exhausted on a number of small parts. No error is greater than to divide a thing into a number of small parts; if we want to know the effect, let us go into a mountainous country, and we shall go on from one mountain to another, and always find the object in the distance of the same comparative smallness. We see the distant peak with clouds lying about the sides, dividing it, and some covering it, some lying in streaks across it, but it does not appear high. We get to the top of another mountain, but a deep valley lies between, and it still does not appear high; we climb from crag to crag, and when we have got to the top we have an unbounded view, but we do not appreciate the immensity of the elevation, we feel rather delight than surprise. Had we seen a precipice, instead of 15 or 20,000, a thousand feet high, the effect would have been different. Many instances might be mentioned, but there is one place in the United States where the view is so terrific, that no courage can encounter it twice. Persons who wish to see this place go provided with guides, and secured with cords, and after looking down become senseless, and when asked always refuse to try it again. So different is it to see a simple elevation, or to see a thing frittered away bit by bit. This is not without its lesson in architecture; the Gothic architects knew it and profited by it. We see it if we look at the Gothic spires and towers with their tops wreathed with ornament; such compositions show that our ancestors understood this effect perfectly. Let us sketch a tower: we have here a great height, but in proportion to the bulk is the apparent elevation reduced; to remedy this, we must do as Barry is going to do at the New Houses of Parliament, we place simple turrets at the corners, sometimes of unequal size to produce picturesque effect. Looking up, the eye runs along this narrow line, and appreciates the full height of the object, at the same time that the bulk is also felt by this combination of parts. The composition of Gothic buildings requires great consideration, both of perspective and composition, as well as of appropriateness of character. If we construct a residence for a clergyman, we must make it comfortable, but at the same time we must give it a certain clerical character; but if we make a house

for a country squire, we must not have anything clerical at all. In the Gothic cathedral immense length was required to provide for numerous processions with music, when the effect produced by them is overcoming. Great elevation was also necessary. We always see, therefore, in such buildings, one part of great length, and as the screen was not originally placed where it now is, but at the entrance, the view was surprising, for while we had figures six feet high close to us, in the distance they were reduced to insignificance. If we look at the means adopted to produce elevation, we shall see that, however numerous the divisions of the columns were to provide the strength required, the architects always took care to have some small fillets, which, being continuous from the bottom to the top, and there vanishing into nothing, give the mind a conception of vast and unlimited height. The contemplation of a cathedral of this kind appears, perhaps, much more elevated, and has a greater effect in raising the imagination than even a mountain itself.

I know nothing in architecture which contains more composition th n Gothic architecture—the Greek temple of vast proportions perched on an isolated rock is simple and majestic—but the Gothic cathedral contains an interminable variety of applications from nature. Having said enough on composition in architecture, I may say that it is of no trifling importance to the historical or landscape painter—both will find excellent studies in Gothic architecture. In the combinations of the architect and the artist there is something more required than mere arrangement of parts, for though the Greek architect is limited to such as are symmetrical, the Gothic is not so strictly limited, and the historical painter is called upon for no symmetry at all, yet composition, to have a lasting effect, must operate on the mind, as much as on the eye. We therefore require a combination of poetical feeling with symmetrical arrangement, for to the architect fine feeling belongs as much as to the artist, and although an architect may not have it in his power to make a cathedral, yet he can show much of the same qualifications in a small building, in furniture and hangings, or in plate for a dining room. Plate is generally ordered at the silversmiths to be made after the pattern of that of Mr. So and So, who had it presented to him for services in the East Indies, but as Mrs. So and So, who has never been in India, must have her plate like that of the other individual, it may be made as similar as possible in shape, and yet far from it in detail, and analogous to the condition of the lady. A case in point occurred to me, I was asked to design a monument for a person who was of a very peculiar character, of good circumstances, had been in trade, and led a very even samely life. The deceased having a relation who had died at the head of his regiment, a monument was desired for him like his cousin's. Here was the contrast, a quiet merchant and a dashing colonel, however I did what I could, and I do hope the thing will not be found fault with. If we have a piece of plate to design, we need not attend most to the weight of the material, but with lighter materials we may endeavour to give an appearance of quantity, making the ornaments bold, and cutting away metal and material in different places—although, by the by, persons do inquire into the weight of metal. I have known this to be the case with Committees of the House of Commons, where silver has been preferred to bronze, because it would make a difference of 150*l.* in the value of the material, though the bronze would have cost more in the end, as the cost of the chasing was greater. There are several things stand much in the way of good composition—want of a fair protection for copyright, and want of judgment in the public. In the many competitions which are advertised every day, the paltry premium offered for the design may be a hundred pounds, while the profit on he work to be executed may perhaps be thousands. There is a third difficulty, and that is want of power, in artists, from the want of fair competition, producing dificiency of high intellect, for those who have the power know better than to exert it on such occasions, they can trust to other ways for making money.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Feb. 8.—Edward Blore, V.P. in the Chair.

Messrs. G. A. Burn and J. J. Cole were elected as Associates.

Among the donations was a copy of Mr. Hay's elegant work entitled Illustrations of Cairo, presented by Mr. Greenough, and Mr. Scoles exhibited an interesting drawing by the late Mr. Bondini of the Cathedral of St. Peter's at Rome, and St. Paul's, London.

The construction of the stone arch, commonly called the stone beam, which exists between the towers of Lincoln Cathedral, having been discussed at a previous meeting of the Institute without any satisfactory results, from the paucity of data which existed in regard to this curious work of science, Mr. Nicholson, Fellow of the Institute, and resident architect at Lincoln, forwarded the following particulars. The arch is at a height of 80 feet from the pavement, immediately over the junction of the vaulting between the towers and the vaulting of the nave; its abutments are thus formed by the eastern walls of the two towers. The arch consists of 23 stones of unequal lengths; the width of the extrados is barely 1 ft. 9¾ in., the thickness of the arch is uniform throughout, 11 inches. The span measured horizontally is 27 ft. 11 in. between its *apparent* abutments, but the arch probably penetrates some more recent casing of the tower walls, so that probably the *actual* horizontal span equals 30 ft. The southern abutment is 12¼ inches higher than the northern. This arch has hitherto been considered the segment of an arch; but the observations of Mr. Nicholson led him to the conclusion, that it is a pointed one, each half arch being struck with radii of different lengths, an inequality arising probably from unequal settlement. It is constructed of stone from the Lincoln quarries, the exposed surfaces being wrought with the toothed chisel in a careless manner. The joints are ill formed, and have a mass of mortar full half an inch thick within them. The arch vibrates perceptibly, and Mr. Nicholson is of opinion that the practice of visitors jumping upon it in order to produce this vibration, may eventually lead to very lamentable results. Mr. Papworth suggested that very probably the arch was constructed by the masons at the time to serve as a fixed mark, by which to test the accuracy of the vaulting of the nave, particularly in the groining stones. But Mr. Nicholson considered this ingenious hypothesis hardly admissable, as the four walls themselves afforded a solid datum by which to control the several levels of the vaultings.

Mr. Poynter read some admirable practical observations on the construction of observatories, with which we hope to furnish our readers at full length in some early number.

Feb. 22.—J. Kay, V. P. in the Chair.

Mr. G. Godwin was admitted as Fellow, and Messrs. Wood and Clarke were elected as Associates.

A volume of exquisite drawings by S. Burchell, Esq., of the details of Prior Birde's chantry in Bath Abbey, and ten guineas from T. L. Donaldson, Esq., secretary for foreign correspondence, were announced among the donations, and two numbers of a very well executed German work on Gothic architecture, now publishing at Nuremburg, were presented by Messrs. Black & Armstrong, booksellers, of London. This publication is remarkable for the judgment with which the subjects are selected, and the tasteful effect with which they are engraved.

A letter was read from M. Vaudoyer, corresponding member, communicating various particulars connected with architecture of recent occurrence at Paris, particularly in regard to Marochetti's monument to Napoleon, which consists of an enormous sphere on a square base, surmounted by an equestrian statue of the emperor with his frock coat and little hat. The style of the monument, and the employment of a foreigner on such a work, has excited much displeasure among the artists of Paris. M. Vaudoyer described a new species of competition, which took place in the time of Louis XVI., who was anxious to complete, in a becoming manner, the Palace of Versailles, then unfinished. Upon the recommendation of Monsieur Le Comte d'Aiguillers, five of the most celebrated architects of the period were introduced to the King, who explained to them his views and wishes, and called upon them to assist him by their talents in rendering the Palace of Versailles worthy the nation. He assigned to each of them 12,000 francs as a complimentary sum, and 3000 francs to cover expences, and gave them 8 months to prepare their designs. The intention was, when Messrs. Chalgrin, Heurtier, Antoine, Peyre Jun. and Paris, the architects chosen, had completed their designs to have them exhibited to the public, and then examined by a jury consisting of the candidates themselves and four other architects. This committee were to make individual reports on each, and a general report on the whole, and to select the two best for recommendation to the King, who was to be at liberty to choose any parts of the other designs, so as if expedient to form a new one composed of the chief beauties in the whole number, and which was to be carried into execution by one or both of the two selected by the jury. The designs were made and paid for, but never exhibited; for the storms of the revolutionary period began to cloud the horizon of the arts, and the scheme, so admirably projected, had no positive results. But M. Peyre published his, in his volume of designs, 1818.

Mr. Scoles, fellow, read an analysis of Col. Howard Vyse's splendid work *on the Pyramids of Egypt.* The great pyramid covers rather more than 13 acres, each side of the square being 764 ft., and the height is 480 ft. 9 in. It is generally supposed that the area of Lincoln's Inn Fields equals that of the Great Pyramid. But it appears that one side of that square between the houses, being 831 ft. and the other 625 ft. 6 in., its area is less than that of the Great Pyramid by about 64,000 square feet. The height of St. Paul's is 365 ft. or 115 ft. 9 in. less than the Egyptian building. Mr. Scoles then minutely described the mode of construction, the arrangement of the chambers and galleries, the objects found, and the chronological history of the erection and events connected with these huge wonders of antique art, tracing it down to the discoveries of the gallant author, and for which we must refer the reader to the work itself. Mr. Perring, a civil engineer, took the dimensions of these edifices, and Mr. Arrundale had the management of the volume, and the preparation of the drawings confided to him by the munificent author. Mr. Scoles' description, which was rendered doubly valuable from his own personal examination of these monuments, was listened to with much attention, and gave rise to some curious remarks by Mr. Hamilton and other members. For our part, we cannot help imagining that there still remain unexplored chambers in these masses of construction, and that discoveries may still repay the patient investigation of future enterprising travellers.

ROYAL INSTITUTE OF ARCHITECTS OF IRELAND.

ADDRESS TO SIR RICHARD MORRISON.

In a recent number of the *Mail* we noticed with pride and satisfaction the honour so deservedly conferred on our eminent countryman, Sir Richard Morrison, by the representative of our most gracious Sovereign. It is no small addition to our pleasure to lay before our readers, in this day's publication, the honourable testimony of the satisfaction which that act of royal munificence has given to a body of gentlemen who, of all others, are best qualified to appreciate the value of the distinction, and to estimate the merits of the individual who has been thus selected for the rewards of her Majesty's favours.

But it is not alone as a favour to Sir Richard Morrison that this honour is to be considered. It is an honour conferred, in his person, on the noble art which, with such credit to himself, and benefit to the public, he has successfully cultivated. The honour due to Sir Richard for his individual merits, was due also to the profession of which he is and has been a distinguished member, and which he has been mainly instrumental in raising to its proper station of dignity and usefulness in this country, by concentrating its genius and its energy in the association from which this address emanates. It has ever been the policy and the practice of the illustrious house, of which her Majesty is no degenerate descendant, to encourage the fine arts by such honours on their professors as the State can confer; and, whilst we refer with pleasure to the distinctions conveyed, in their professional capacity, on a Reynolds and Chantrey, it gives us no less pride to find our countrymen—a Shee and a Morrison—equally honoured by the distinguishing approval of the Sovereign.

In this instance, at least, justice to the individual has been "justice to Ireland," honour to Sir Richard Morrison, an honour to his profession.

The address was presented to Sir Richard on the 5th ult., at his residence in Mount Street, by a distinguished deputation from the body, and read by John Papworth, Esq., the honorary secretary, after the following brief, but well conceived prefatory observations:—

"Sir Richard Morrison, the duty which devolves upon me this day, as secretary to the Royal Institute of the Architects of Ireland, I feel to be one of an extremely important and interesting nature, whether we consider it with reference to our own profession, or to the fine arts in Ireland. I am highly honoured to be the medium through which the sentiments of our institution are to be conveyed to you, on the occasion of that honourable distinction which has been conferred on you. I am aware my associates around me participate in the feelings of pleasure which I entertain at this moment. It is unnecessary for me, Sir, to dwell upon the circumstance which has brought us together this day, as it is fully expressed in the address which I shall now have the honour to read."—*Dublin Mail.*

SOCIETY OF ARTS FOR SCOTLAND.

January 25.—Dr. FYFE, President, in the Chair.

Professor Forbes gave, at the request of the President and Council, an exposition of *The Doctrine of the Polarization of Heat*. On this evening he proposed to give an account of the instrumental measurement of temperature. This introduction was illustrated by examples of the various instruments in use, from the air thermometer of Sanctorius, to the delicate thermomultipliers of Nobili and Melloni. In the course of this historical account, he adverted to a recent ingenious improvement of the common flint thermometer, by M. Vültz, and which, he believed was not yet published: this improvement consists in sinking the tube to the depth of two-thirds of its diameter into the material of the scale; by which arrangement the parallax in one direction is compensated by the refraction in another, so that, in all positions of the eye, the degree read off is the same.

A description of *A Self Inking Press* was read, illustrated by drawings and working model, by Mr. John Napier, which was remitted to a committee; and afterwards a short notice of the completion of the printing of the whole Bible in relief for the use of the blind, by John Alston, Esq., Rosemount (Glasgow); for which he was congratulated by the Society.

February 8.—SHIRREFF L'AMY, V. P., in the Chair.

The President read an interesting account of a series of extensive experiments *On the Evaporating Power of various kinds of Coal*, (including the anthracite), as obtained by combustion in furnaces. The general result of these experiments seemed to be that the practical heating power of all coals is almost exactly in proportion to the quantity of fixed carbon; there appearing to be no heat whatever procured from the volatile matter of the coal. This circumstance Dr. Fyfe accounted for by supposing that the hydrogen and volatilized carbon abstract, in passing to the gaseous state, as much heat as they develop during combustion.

Mr. Sang drew the attention of the Society to an erroneous deduction drawn by the late Capt. Henry Kater, from his experiments on *the flexure of bars*. Capt. Kater had observed that the elongation of the distance between two marks on the surface of a bar when the bar is supported at the middle, is hardly half of the contraction caused by supporting the same bar at the two ends (the mere reduction on account of curvature having been allowed for in both cases). And he had thence concluded that the neutral plane is not, as is usually supposed, in the middle of the thickness of the bar, but only at one-third of that thickness from the convex side. Mr. Sang showed that this result would imply that bodies resist distention with eight times the energy with which they resist compression: and he pointed out that the disparity observed by Capt. Kater is due to the difference of curvature in the two states of the bar, and that that disparity agrees with the deduction of the ordinary theory of flexure. He also pointed out some errors in Capt. Kater's methods of computation and experimenting which seemed to him to destroy all confidence in any of that philosopher's experimental results.

Royal Victoria Gallery, Manchester.—A long discussion has taken place at this institution upon Mr. Palmer's plan for the improvement of the Mersey and Irwell Navigation. In this discussion Mr. Radford, Mr. Hawkshaw, Mr. Buck and other eminent engineers took part; it is, however, reported at too great length to allow us to notice it this month. We are glad to see so much interest taken in engineering in that part of the country, and we should like to see Institutes at Manchester and Newcastle. The architects have already an Institute at Manchester, and the engineers should not be outdone.

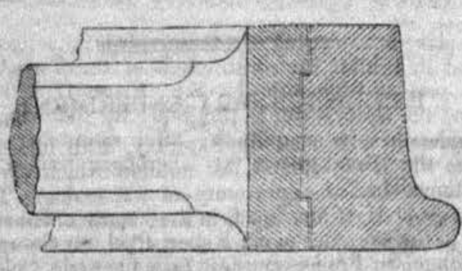
Royal Scotch Academy. (From an Edinburgh Correspondent.)—This exhibition is now open, and it is an admirable one; the progress which is being made in art in this country is very satisfactory. There are few architectural designs, which is not to be wondered at, as the accommodation for drawings is miserable, every thing being sacrificed for oil paintings, the veriest daub in oil having a better place than a chef d'œuvre in water colour. We are even worse off in this respect than you are in London, inasmuch as the little room given to our architecture and water colours is further curtailed by the introduction of the *sculpture!* the specimens of which, with the exception of the works, by members or associates of our Academy, are in most instances below criticism. Our Associations or "Art Unions" are reported to have larger funds this year than last, so that 8 or 9000 pounds will probably be spent in art this year. The last sum must be nearer the truth if general report may be depended on.

EXTRAORDINARY EXPERIMENT.

AN experiment was tried on Saturday, 20th ult., of one of the inventions to which we alluded last autumn, which a friend on whom we have reliance had an opportunity of witnessing. The trial took place in the grounds of Mr. Boyd, in the county of Essex, a few miles from town, in the presence of Sir Robert Peel, Sir George Murray, Sir Henry Hardinge, Sir Francis Burdett, Lord Ingestrie, Colonel Gurwood, Captain Britten, Captain Webster, and some other gentlemen, who all appeared very much astonished at what they saw. By the kindness of the inventor our informant occupied a position that enabled him to command a view of all that took place. A boat 23 feet long and 7 broad was placed in a large sheet of water, the boat had been the day before filled in with solid timber, four-and-a-half feet in depth, crossed in every direction, and clamped together with eight inch spike nails. This filling in was made under the inspection of Captain Britten, who stated the fact to the distinguished gentlemen we have mentioned, and also that the inventor never went near the workmen employed, that no suspicion might be entertained of any combustible materials being lodged in the hold of the vessel. Several of the gentlemen were on Saturday rowed in a punt to the vessel, and examined for themselves, so that every doubt might be removed as to the cause of destruction being external, and not from the springing of any mine. When the different parties had taken up their positions, on a signal from the inventor, the boat was set in motion, and struck just abaft her starboard bow, and instantaneously scattered into a thousand fragments. At the moment of collision the water parted, and presented to the eye of our informant the appearance of a huge bowl, while upon its troubled surface he noticed a coruscation precisely resembling forked lightning. A column of water was lifted up in the air like a huge fountain, from which were projected upwards for many hundred feet the shattered fragments of the vessel, which fell many of them several hundred yards' distance in the adjacent fields. Our informant examined many pieces, and found the huge nails snapped like carrots; the mast looked like a tree riven by lightning, and never before, as he assures us, has he witnessed so sudden and complete a destruction, though he has seen shell and rocket practice on the largest scale. Such seemed to be the unanimous opinion of all present. How this mighty effect was produced was of course not disclosed to so numerous a party, but two naval officers present were perfectly aware of the mode of operation, and the

inventor offered to go into details confidentially with one or two of the distinguished officers present. In answer to a question from Sir Henry Hardinge, the inventor stated that without a battering train he could transport on a mule's back the means of destroying the strongest fortress in Europe. No doubt this is very startling, but, hearing what we have, we cannot pronounce it impossible; and as in every particular the inventor has done what he has undertaken to accomplish, it is only fair to give him credit for the performance of more than has yet been disclosed. The existence of these tremendous powers is placed beyond all doubt, and the inventor asserts them to be completly under his control, which, from what our informant has had an opportunity of observing, he believes to be really the case. The instrument that wrought so terrible an effect on Saturday, lifting into the air a boat weighing two and a half tons, and filled in with five and a half tons of solid timber, and displacing at least fourteen or fifteen tons of water was only 18 lb. weight. Our informant has handled it and kicked it round a room when charged with its deadly contents, so portable and at the same time so safe is it—a point of vast importance, when we remember the daily accidents that are occurring from the detonating shells now used in our service. At Acre most of those employed burst before they reached their object, and they are liable to explode when rolling about a ship's deck, as was proved by the fatal accidents on board Her Majesty's ship Medea, off Alexandria, and the Excellent, at Portsmouth, and are dangerous to carry in a common ammunition cart on a rough road. Whether Lord Melbourne will condescend to examine into this matter, and secure these mighty powers for this country, or permit them to pass into the hands of our enemies, is more than we can venture to predict, but about which we cannot think England will remain indifferent. The inventor has requested us publicly to return his thanks to Mr. Boyd for his great krndness in permitting him the use of his grounds not only on this but on several occasions.—*Times*.

IMPROVED TIRE OF A RAILWAY WHEEL.



Annexed is a small sketch of a section of the tire of a railway wheel, showing a new mode of fixing the outer tire.

Many accidents, particularly to the machinery of locomotive engines, have occurred from the bolts (which are used in general, but in my improvement are not *necessary*) breaking, and allowing the tire to work off laterally, and to come in contact with the working gear. The improvement consists in having a groove turned out of the wheel, and a corresponding tongue on the inside of the tire, as shown in the sketch, which prevents the possibility of the tire coming off, but by its breaking, a contingency which but seldom happens.

H. W.

Manchester, Feb. 4th, 1841. *Railway Times*.

HISTORY OF THE LONDON AND BIRMINGHAM RAILWAY By THOMAS ROSCOE,

Assisted in the Historical Details by Peter Lecount.

Sir—In your last number a communication appears from Mr. Lecount, animadverting on the use of his name in the above work, and also on the publishers for not paying him for his services. Having had the entire direction of the publication of this book, I feel it necessary to say that these statements are grossly incorrect, and that I am ready to prove this when called upon.

Mr. Lecount says "after page 32 I had nothing whatever to do with it, and my name being connected with it is a perfect hoax upon the public." So far from this being correct, I can produce scores of pages of Mr. Lecount's manuscript which are printed in various parts of the volume! It is extremely unpleasant to bring forward the names of gentlemen, and I will here merely remark, that the manner in which his name is printed on the title page of the volume, was agreed to by himself, in my presence, at the suggestion of his solicitor at Birmingham! Indeed if it were improperly used, an injunction could readily be obtained to restrain such an imposition on the public—but Mr. Lecount finds it easier to write scurrilous remarks, than establish that which has no foundation in truth.

By implication he charges the publishers with breach of agreement, wilfully mis-stating facts. He says, "what I furnished for that work although done under a written agreement, has never got me a sight of sixpence of the publisher's money." If such were in reality the case, Mr. Lecount would not be long in claiming his right. I deny, in unqualified terms, any treatment of Mr. L. otherwise than the most honourable. For what services he rendered, he was remunerated by having a pamphlet of about 100 pages printed, which was afterwards "wasted," a single copy only being kept to prove the fact of its having been printed; and I have now before me, in Mr. Lecount's hand writing, a memorandum of the cancelling of the original agreement which was for a pecuniary consideration.

I am, Sir, your obedient servant,

Wareing Webb.

Castle Street, Liverpool,
February 18, 1841.

ERRORS IN SCIENTIFIC BOOKS.

Sir—It is a little surprising that a few of the most gross and palpa ble errors as represented in some of the Plates, both in the old and new editions of "*Tredgold on the Steam Engine*," should have remained so long unnoticed, particularly in Europe, where so very many skilful and scientific mechanics are continually poring over works in every department of science.

The first and only error, I shall *now* draw your attention to, is on plate No. 11, where, in the figure of a steam engine pumping water from a mine, the pump rod is connected with the piston rod *i*, *h*, to produce a parallel motion in both it and the pump rod, which exhibits a profound ignorance of mechanics, on the very face of it, (as there delineated) for though the piston rod will move parallel, the lifting pump rod at the other end of the beam will not.

I have heard of a London waiter getting a quart of wine into a pint decanter, but never heard of the diagonal of a square (or of a parallelogram) being crammed into either diameter of it. I have heard also of a man who affirmed *that nothing was impossible, and that he could bite his own ear off*; but after repeated contortions of the head and other attempts and trials, he gave it up: observing, however, that he *knew it could be done with a sudden jerk*. Perhaps a diagonal can be crammed into the square, as represented in the figure alluded to, in Europe, but to us ignorant folks in the Western World it looks rather "*slanting-dicular*," makes us rather sceptical, and indeed seems impossible to accomplish, even with a *sudden jerk*: but, like our inquisitive neighbours, the Yankees, if it *can be done*, we are "*kind a' curious*" to know *how*.

As books of science are generally published to instruct the unlearned or uninitiated, it would be as well to have the figure 5, on Plate X (A) *engraved so as to be understood*, because as there represented, it now requires a person who already understands his business, to understand how to construct the parallel motion *as there represented*. The same figure is repeated in the following plate, No. X (B).

If the insertion of this little inquiry is not inconsistent with your sense of duty to the public, please to notice it in your useful publication, and you may perhaps hear again from,

Your very obedient servant,

Robert Rational.

British North America,
January 20, 1841.

REVIEWS.

Papers on Subjects connected with the Duties of the Corps of Royal Engineers. Vol. IV. London: Weale, 1840.

We mentioned in our last our favourable impressions as to the manner in which the character of this interesting work is maintained, and it gives us pleasure this month also to bear further testimony towards it.

The volume is appropriately preceded by a memoir of the professional life of the late Thomas Drummond, from the pen of Captain

Larcon, which, restricted as it necessarily is, still shows enough to enable us to appreciate the character of that amiable man.

The first, second, sixth and seventh papers are on subjects purely military, which prevents us, on the present occasion, from making any comment upon them.

The third paper, by Lieut. Nelson, R. E., is on the important subject of shot furnaces, a question in the consideration of which the construction of iron steam vessels should also enter. In this paper we are glad to see an acknowledgment of the valuable suggestions of Sir John Guest and Mr. Evans.

Lieut. Caffin's description of a new steam apparatus for drying gunpowder, shows that he has introduced an important improvement, which we trust will be adopted by the authorities.

The memoranda on blasting rock, by Major General Sir J. F. Burgoyne, form a work, and a most valuable one, in themselves; we cordially recommend them to the attention of our engineering readers of every department.

Major Harry Jones's paper, the eighth, gives an account of the well in Fort Regent, Jersey, a work of great difficulty and great success. Major Jones also gives his personal testimony to having witnessed the successful operation of the water finders with the *baguette divinatoire.* It is curious, but we do not know what to say to it.

Captain Brandreth's report on the Island of Ascension is valuable and interesting, but does not fall within the scope of our observations.

The tenth paper is by Major Bolton, R. E., and is descriptive of the dam constructed across the waste channel at Long Island, on the Rideau Canal. To this we may afterwards have occasion to refer.

Lieutenant Nelson has contributed a series of notes which he calls engineering details, a memoir which must be useful, both as an example and a lesson to the younger members of his corps.

The description of the New Victualling Establishment at Devonport bears ample testimony to the ability of the two Rennies, under whose direction many of the works have been executed. It will be seen, by other examples, that the civil engineer has full attention paid to him in this work.

Mr. Howlett, the chief draughtsman of the Ordnance, describes an ingenious plan of his for connecting a locomotive engine and tender to a passenger train, in which we only see one difficulty—how it would work on sharp curves.

Lieut. Denison, the able editor, is author of the fourteenth paper, on a new weigh bridge, lately erected at Woolwich Dockyard, and also of the next, containing an account of another new work in the same establishment, a single coffer-dam.

The sixteenth and seventeenth papers on injecting cement into leaky joints of masonry, and on the employment of sand for foundations, are translations from the French.

The eighteenth paper is on the rolling bridge at Fort Regent, Jersey.

The nineteenth paper brings us again to a contribution of the editor, describing the mode adopted for restoring the roof of Woolwich Dockyard Chapel, on the failure of the principals.

The twentieth paper is on the wharf cranes made by the Butterley Company, communicated by Joseph Glynn, Esq., F. R. S., and the twenty-first on Mr. Woodhouse's cast iron bridge over the River Trent, at Sawley, on the Midland Counties Railway.

Reports, Specifications and Estimates of Public Works of the United States of America. Edited by W. STRICKLAND, Architect, C. E.; EDWARD H. GILL, C. E.; and H. R. CAMPBELL, C. E. London: John Weale, 1841.

When the "Public Works of England" first appeared, we expressed our approbation of the superior manner in which Mr. Weale had brought out that valuable work, an opinion which was fully borne out by the countenance of the public, and the satisfaction of the profession. It is at once a proof and a result of the success of Mr. Weale's exertions, that our Transatlantic brethren have entrusted to his care a similar volume on the Public Works of America. It affords us double pleasure to see that they have commenced so well, and that they have taken such an effective step to do justice to their works. The present is a companion to the former work, and is fully equal to it, it shows the same careful selection of subjects, the same fulness of details, and the same splendour of execution. We have no doubt of its success with the profession, for every exertion has been made to deserve it, and it has our heartiest wishes, not less for its intrinsic merits than for the good it is calculated to do the profession. We know nothing better adapted to promote professional studies, and to elevate the character of such pursuits among the public, than the productions of works like these, which are the best monument to the old practitioner, and the best lesson to the beginner. This, we are sure, is but part of a series, for the success of the result we trust will embolden Mr. Weale to give us also the Public Works of the Continent, and thus lay the foundation of a museum of practical information, to which every department of the profession may have recourse.

We shall now proceed to detail the contents of the first two parts of the work before us. The first 13 plates represent the Philadelphia Gas Works, constructed in 1835, under the direction of Mr. Merrick; the following extracts will show their extent:

The works are laid out in eight distinct sections of ten "benches," or thirty retorts each, making an aggregate of two hundred and forty retorts. Each bench yields upon an average 10,000 cubic feet of gas daily, or, when in full action, an aggregate of 800,000 feet.

To each section is a distinct washer, purifier, condenser, and station meter. The two retort-houses are each 200 feet long and 50 feet wide, located in the centre of the square, having between them a passage of 40 feet, which is excavated as a cellar and floored over water-tight. This passage and the arched cellars under the retort-houses serve as coal stores.

Each retort-house contains one stack and four sections of retort benches, built back to back down the centre of the building on each side of the chimney. The apparatus for cleansing the gas is located to the north and south of each retort-house respectively. Two sections of retort benches are now completed and in action, and a third is now in the course of erection.

The retorts are the broad or York D's, 20 inches by $7\frac{1}{2}$ feet in the clear, set upon an original plan.

The gas is washed in two waters through washers of simple construction, with valves so arranged as to use either as the first, the most pure water being used as the second. The condensers are of ordinary construction, modified so as to enlarge the receptacle for the residuum at the base of the columns. The purifiers are constructed for dry lime, with a hydraulic seal for shifting, by which the use of valves in the purifying house is avoided.

After passing the meters, the gas from all the sections mingles in the gasometers or gas-holders.

Appended to the description of the Gas Works there are some valuable reports upon the construction of the works, the cost of making gas, &c.

The next plate is a drawing of a Reservoir Dam across the Swatara. Plates 15 and 16 exhibit the construction of the Twin Locks on the Schuylkill Canal at Plymouth (U. S.) Plates 17 & 18 the bay of Delaware and the Breakwater in progress; the following extract from the report describes its magnitude; after examining into the construction of the Breakwaters at Cherbourg and Plymouth, the report recommends;

The inward slope at 45°, the top 30 feet in breadth, and at $5\frac{1}{3}$ feet above the highest spring-tide; the outward slope of 39 feet altitude, and of $105\frac{3}{4}$ feet base; both dimensions measured in relation to a horizontal plane passing by a point taken at 27 feet below the lowest spring-tide. The base bears to the altitude nearly the same ratio as similar lines in the profiles of Plymouth and Cherbourg Breakwaters.

The part comprehended between the sea bottom and a horizontal plane 6 feet below the lowest spring-tide, the mass to be formed of stones weighing from $\frac{1}{4}$ to 2 tons, those of 2 tons comprising three-fourths of the mass. The slopes of this part to be covered with blocks weighing from 2 to 3 tons.

For the part comprised between the latter horizontal plane and the lowest spring-tide, the mass to be composed of stones weighing from $\frac{1}{4}$ to $2\frac{1}{2}$ tons; those of $1\frac{1}{2}$ to $2\frac{1}{2}$ tons forming three-fourths of the mass. The slope of this part to be protected by blocks weighing 3 tons.

For the part comprehended between the lowest and highest spring-tide, the mass to be formed of blocks weighing from 4 to 5 tons, and laid as regularly as practicable. The slopes of this part to be formed of the largest blocks and to be laid headwise.

The estimate submitted by the Board was as follows:—The profile of the work rests on a bottom of $29\frac{4}{10}$ feet, on an average, below the lowest spring-tide, and has a superficies of 535,472 square yards; which, being multiplied by 1700 yards (the whole length of the work), gives for the capacity of the mass $910,302\frac{4}{10}$ cubic yards.

Plates 19 to 24 exhibit the construction of the Philadelphia Water Works, the following description will give an idea of their extent:—

It has been from the commencement determined, for the present, to erect only three wheels and pumps, which are now completed, (there are now six), and with them the most important part of the duty of the Committee. The first of the wheels is 15 feet diameter and 15 feet long, working under 1 foot head and 7 feet fall. This was put in operation on the 1st of July, 1822, and it raises $1\frac{1}{4}$ million gallons of water to the reservoir in twenty-four hours, with a stroke of the pump of $4\frac{1}{2}$ feet, a diameter of 16 inches, and the wheel making $11\frac{1}{2}$ revolutions in a minute. The second wheel was put in operation on the 14th of September, 1822, and is the same length as the first, and 16 feet diameter; it works under 1 foot head and $7\frac{1}{2}$ feet fall, making 13 revo-

lutions in a minute, with a $4\frac{1}{2}$ feet stroke of the pump, and raising $1\frac{1}{3}$ million gallons in twenty-four hours. The third wheel, which went into operation on the 24th of December, 1822, is of the same size as the second, and works under the same head and fall, making 13 revolutions in a minute, with a 5 feet stroke of the pump, and raising $1\frac{1}{3}$ million gallons in twenty-four hours. It is not doubted that the second wheel can be made to raise an equal quantity; thus making the whole supply upwards of 4,000,000 gallons in twenty-four hours.

The wheels are formed of wood, and put together with great strength. The shafts are of iron, weighing about 5 tons each. The great size and weight of the wheel give it a momentum which adds greatly to the regularity of its motion, so necessary to preserve the pumps from injury under so heavy a head as they are required to work, which is a weight of 7900 lb.; the height 92 feet.

The following statement exhibits the extent of the works, the number of tenants supplied, the quantity of water daily distributed, and the amount of revenue for the years 1823 (at which time the city only was supplied with water) and 1837 respectively. In 1823 the three wheels and pumps were in operation, $6\frac{1}{2}$ miles of iron pipes were laid, 4,844 tenants were supplied with 1,616,160 gallons of water daily, and the revenue was 26,191·05 dollars per annum. In 1837 six wheels and pumps are in operation, $98\frac{3}{4}$ miles of iron pipes are laid, 19,678 tenants are supplied with 3,122,164 gallons of water daily, and the revenue is 106,432·37 dollars.

Plates 25 to 40 contain drawings of Dams and Locks, and Aqueducts of various canals on the James River.

The reports and specifications, which are published in a separate work, are drawn up with considerable care, and show that the profession in America are well acquainted with the practical department of civil engineering.

Railway Transit; a Letter to the President of the Board of Trade. By FRANCIS ROUBILIAC CONDER, C.E. London: Weale, 1841.

In this pamphlet Mr. Conder has gone into the consideration of almost every detail connected with the working of a railway, illustrating the subject by many ingenious and practical suggestions. On most points we agree with Mr. Conder, although we must reserve our opinion as to some other of his suggestions. To the profession this pamphlet will be of great interest, as it advocates their cause with ability and justice.

A Manual of Logarithms and Practical Mathematics. By James Trotter. Edinburgh: Oliver & Boyd, 1841.

This work is from the pen of one of the tutors in the Scotch Naval and Military Academy at Edinburgh, and fully answers to its title. It is one of the best and cheapest manuals with which we are acquainted.

The Year Book of Facts in Science and Art for 1840. By the late Editor of the "Arcana of Science." London: Tilt, 1841.

We, in common with the scientific and professional press who contribute to the Year Book of Facts, may almost be considered as interested while speaking in favour of a work to which our own columns contribute; we are therefore obliged to leave it to the judgment of the public, by calling upon them to purchase and examine it for themselves. We cannot, however, refrain from saying that it is a most valuable compilation, indispensable to the student and man of science.

Gandy and Baud's Windsor Castle. London; Williams.

A third part has appeared of this splendid work, which we lately noticed. It contains a number of valuable and interesting engravings, so that the present subscribers have every reason to be gratified with the exertions of the editors, which we have no doubt will be farther successful in ensuring for it an extensive circulation.

Description of a new Quart and Bushel Measure, by T. N. Parker, Esq., M.A., is a pamphlet on a new system of measures. Mr. Parker proposes that the gallon shall contain 256 cubic inches, so as to give greater facilities in calculation.

A new coloured lithograph of *Menai Bridge* by Mr. Gauci, has appeared—we recommend it to the attention of our readers.

Tyas's National Map of England.—We have before us a proof of No. 11 of this cheap and excellent map, which for clearness of execution, and accuracy, we believe to be superior to any map of its scale, extant, it shows nearly the whole of Sussex, with a large portion of Kent and Surrey. It is so arranged that every sheet is perfect in itself, or any number of sheets may be joined together.

A new edition will shortly appear of Peckston's Practical Treatise on Gas, with numerous plates, corrected and adapted to the present improved state of the manufacture.

NEW IMPROVEMENTS IN THE DAGUERREOTYPE.

On the 4th of January, at the sitting of the Institute, M. Arago announced that M. Daguerre had discovered the means of fixing the Daguerreotype pictures in the wonderful short space of half a second, or in other words instantaneously. This quite unexpected result will henceforward enable the Daguerreotype operator to obtain the representation of living and moving objects, of all which animate a picture. Our streets, squares, bridges and rivers, will not be as before, represented in the middle of the day plunged into a deadly solitude, but they will show us in reality all the animation which gives interest to a picture. The admirers of the Daguerreotype, and they are numerous among the well educated part of the community, are eagerly awaiting the disclosure of the important improvements of M. Daguerre, and we are sorry to hear that the ingenious inventor will not be able to bring his improvements before the public for a few months to come.

We understand that the improvements consist only in shortening the time of the operation, and that the effect produced will not be better than before. In fact we have with infinite gratification admired the specimens obtained by the original plan, which are exhibited by Messrs. Claudet and Houghton, in their numerous and beautiful collection, and we cannot conceive how it would be possible to improve them, except by the addition of living or moving objects.

STEAM NAVIGATION.

RENNIE'S PATENT TRAPEZIUM PADDLE WHEELS.

The object of the above patent is to do away with the defects of the common rectangular paddle wheel, arising out of its great width, weight, and indirect action, and to substitute in its place a wheel which, while it retains the simplicity, obviates the defects of the common paddle wheel. The Trapezium paddle wheel differs only from the common paddle wheel in the form of its floats, which are trapezoidal or spear-shaped, and in the greater simplicity of its construction. The advantages to be derived from this form are a wheel of one half the breadth, one half the weight, and one half of the surface of the common recangular paddle wheel. These advantages require no comment, provided that the form of wheel be equally efficient, and this has been proved by a series of experiments on two separate steam vessels, in opposition to their usual wheels. From the peculiar form of the floats, they enter into the water with the pointed part of the float downwards, and thus gradually arrive at their full horizontal action without shock or vibration, while, after the stroke, they, in the reverse manner, quit the water without raising any portion of it behind. Of course the advantages, arising out of the diminished breadth of a vessel fitted with trapezium-shaped floats, will be, less space occupied in a river, basin, or lock; less surface resistance to a head wind, by all the breadth of one wheel; lighter draught of water, by the diminished weight; less oscillation sideways, and consequently less liability to occasion damage to the engines. The shocks and vibrations now experienced by the striking of the edges of the rectangular paddle wheel against the surface of the water, and the loss of power occasioned in consequence by the oblique action of the wheels both in going into and out of the water will be entirely prevented. Finally, that that the Trapezium paddle wheel will work nearly as efficiently when deeply immersed as when immersed to the usual depth, thus enabling the wheels to work with nearly the same facility at the first as at the last part of a vessel's voyage. All these advantages are obtained without the aid of wheels, eccentrics, or complicated levers of any kind, but simply an alteration in the form of the floats; H. M. ship *African* is now being fitted with Trapezium paddle wheels, instead of her former rectangular paddle wheels.

North America.—In a week or ten days (says the *New York Herald*) one of the most substantial and splendid steam ships in the world will be launched in this city. This steam ship, or steam frigate rather, is owned by Nicholas, Emperor of Russia. She is of immense size, and has been building since last spring. Her dimensions are as follow:—Length of deck 220 feet; length of keel 210 feet; breadth 36 feet; full depth $24\frac{1}{2}$ feet; tonnage 1,500. She is constructed of live and white oak, but mostly of the latter kind, weighing, we believe, about fifty pounds to the cubic foot. She will draw, when launched, ten or eleven feet of water and no more. But when her engines, and boilers, and guns, and all her machinery and her fuel

of which she can carry about eight hundred tons, are in, she will probably draw five feet more. The model of this great war steamer was drafted by two officers of the Russian Navy. But of the steam frigate—no vessel of the kind that has ever crossed the Atlantic is like her. She is superior to the *Western*, the *Queen*, and the *President*. (?) Her bows are sharp—her stern is round—her bend is gradual and symmetrical—her wheel-houses are neat and not too large, and her whole appearance is rich, attractive, and man-of-war like. She has three masts, which, together with her rigging, are very light. This will contribute, in a great degree, to her speed against head winds. Large unwieldly spars are decidedly bad, when winds are unfavourable. Her internal arrangements will be neat, chaste, and beautiful. Her armament is to be very formidable. She can discharge at every broadside more than four hundred pounds of shot! She will mount sixteen fifty-four and thirty-two pounders on the second deck, and two ninety-six pounders hollow shot, called by the humane, death dealers, on the upper deck, which is flush fore and aft —a clear run of two hundred and twenty feet. Her engines will be about six hundred horse power. They will be equal to the ship, for no expense is to be spared in having them perfect. What her speed will be, is, of course, not yet known. We can only guess that she will go pretty fast, if not faster. Another account says—A splendid steam frigate, built at New York, for the Emperor of Russia, was launched on the 24th November. She is to be called the *Kamtschatka*, and is of the burden of 2,281 tons, of the length of 246 feet 6 inches. Breadth across the paddle wheels, 66 feet. Her armament is to consist of twelve 36 pounders, four 54 pounders, and two 96 pounders for throwing hollow shot.

Steam Navigation.—If the French Government carry their proposition for admitting the importation of foreign marine steam engines free of duty, it will give extensive employment to the engine manufacturers in this country, and greatly extend French steam navigation.

West India Mail Steam Packet Company.—This Company have in hand 14 steam vessels of 1400 tons burthen, each to be fitted with a pair of engines of 220 horse power—6 pair are being made in the Clyde, 2 pair by Fawcett and Co., 2 pair by Maudslay and Field, 2 pair by Miller, Ravenhill and Co., and 2 pair by Acraman and Morgan—the parties are under heavy engagements to have them ready within a very short time.

New York.—We believe that we are at last enabled to announce the establishment of a New York line of steam ships between New York and England. The preliminaries are, we understand, nearly completed, and within a short time the keels of four gigantic vessels will be laid. They are to be about 2,000 tons, with engines of 800-horse power.—*New York Commercial Advertiser.*

The City of Dublin Steam-packet Company.—We understand that this Company have decided on laying down two new steamers immediately, to run, in conjunction with their unrivalled vessels, the *Prince* and *Princess*, to and from Kingstown. As the utmost speed that can be attained is determined on without regard to expense, the contracting parties are bound, under heavy penalties, to construct them to outstrip any sea-going steamer afloat; and it is confidently anticipated, that the average passages will not exceed nine hours.—*Liverpool Albion.*

PROGRESS OF RAILWAYS.

GRAND JUNCTION RAILWAY.

Expenditure to December 31, 1840.

	£	s.	d.
Engineering, surveying, parliamentary, legal and general expences; construction of line and works, stations, land and compensation, rails, chairs, &c.	1,616,606	10	10
Locomotive engines and tenders, and establishment—carriages, wagons, trucks, and horse boxes	228,094	16	0
Purchase of Warrington & Newton line	65,463	7	4
Purchase of Chester and Crewe line	192,550	0	0
Expended to Dec. 31, in works, &c. on Chester & Crewe line	65,475	14	3
Interest on loans previously to the completion of the line	22,270	18	3
Arrears of fourth call on half-shares, less received on account of fifth call on do., and Warrington & Newton interest not applied for	1,585	8	9
Total	£2,192,046	15	5

Value of Stock, December 31, 1840.

	£	s.	d.
Locomotive Engine Department	109,215	6	8
Waggon, horse box, and carriage truck department	53,451	7	5
Coach-building department	51,843	14	3
Total value	£214,510	8	4

Manchester and Birmingham Railway.—The Directors of the Railway have, by a *unanimous* vote, awarded to John Blyth, Esq., V.P. of the Architectural Society of London, and R. Cromwell Carpenter, Esq., F.S.A., the premium of two hundred pounds for their designs for the Manchester Station.

The Strasburg and Basle Railway Company has just received from the bank of France the sum of 4,200,000f. on a warrant from the treasury, being the first of the three instalments of 12,600,000f. which the French government is authorised to lend it. The Company therefore is about to adopt additional measures for carrying on their works.

LONDON AND BIRMINGHAM RAILWAY.

Expenditure to December 31, 1840.

	£	s.	d.
To land and compensation	721,566	14	3
To works of road and stations	4,348,269	12	5
To locomotive stock, viz.—engines, tenders, tools, and implements	154,635	0	7
To carrying stock, viz.—coaches, trucks, wagons, cranes, &c.	195,310	5	0
To charges, viz.—			
Obtaining act of incorporation	72,868	18	10
Law charges, conveyancing, engineering, advertising, and printing, direction, office expenses, salaries, and sundries	172,175	9	0
To interest on loans, previous to general opening, 17th Sept. 1838, and debenture charges	127,649	8	6
Total	£5,792,475	8	7
Value of locomotive engines and carriage stock, Dec. 31, 1840	£349,945	5	7

394,688 passengers travelled on this railway during the last year, each an average distance of 65¾ miles.

LONDON AND GREENWICH RAILWAY.

Extracts from the last Report.

The cost of locomotive power, per train, has been 1*s.* 2¾*d.* per mile.

Relaying of the line, together with the asphalting over nearly 500 arches have been completed, and the new rails on cross sleepers laid thereon, and, so soon as the season of the year will permit, the remainder will be proceeded with. —1,566,736 passengers were safely conveyed over this line during the past year.

In conformity with an act obtained last session, empowering the Company to increase the width of the railway from the London station to the junction with the Croydon Railway, so as to admit of four lines of way instead of two, as heretofore, two contracts have been entered into for widening the railway as above mentioned, and which extend over about 2,400 yards, leaving only about 660 yards of the line and the addition to the station to be contracted for. A list of the tenders for the first contract was given in the Journal for last December, and we now annex a list of tenders for the last contract.

Messrs. Little & Sons	£16,350
Messrs. Lee	17,628
Mr. Jackson	17,650
Messrs. Grissell & Peto	17,734
Mr. Grimsdell	17,986
Mr. Munday	17,988
Messrs. Ward	18,650
Mr. Bennett	18,764
Messrs. Baker & Son	19,340
Mr. Mac Intosh	21,283

BLACKWALL RAILWAY.

List of Tenders for the extension from the Minories to Fenchurch-street, delivered in on the 23rd ult.

Jackson	£29,800
Webb	30,333
Baker and Son	31,888
Lee	32,333
Piper	32,690
Grissell and Peto	33,000
Grimsdell	33,120
Cubitt	33,940
Bridger	34,900

Stockton and Hartlepool Railway.—On Tuesday the 16th ult., this new Railway was opened by the Directors, and on the following day to the public. It connects the flourishing ports of Stockton and Hartlepool, and must prove a convenient means of communication between the two places. The undertaking altogether reflects the highest degree of credit on the public-spirited company who are engaged therein, and also on the talented engineers and their assistants, and the contractors who have been employed in executing the work. In point of fact, we shall not overstate our feeling on this subject, if we remark that the way in which the works have been finished on the Stockton and Hartlepool railway affords a model of railroad construction. Messrs. George Leather and Son, of Leeds, are the engineers-in-chief, and Mr. John Fowler, their assistant, was the resident engineer.—*Leeds Mercury.*

Railway to Cambridge.—In the last month there have been no less than three different surveys between Bishops Stortford and Cambridge, one for extending the line of the Northern and Eastern Railway to the latter place; one line by the East Anglian Railway; and the other for the railway to York, through Lincoln. We certainly think it a great fault in the present state of affairs for new companies, as in the above case, to attempt to do too much. It would have been far better for the projectors of the lines from Norwich and York, to have made an arrangement with the Northern and Eastern Railway Company to have completed their line to Cambridge, from which the other two lines could then have diverged, and at some future time a line to the westward, through Bedford to Rugby, and unite with the London and Birmingham Railway. By such a step the expense of conflicting surveys, and perhaps of a parliamentary contest would be avoided, and the Eastern Counties really benefited.

The Sheffield and Manchester Railway.—It appears the works in the centre tunnel are going on night and day, the men working "shifts." But when we find it is three miles, or 5,280 yards in length, and there are five shafts to sink of the following depths, some time must elapse before this great work is finished:—Shaft No 1, 180 yards deep; No. 2, 194 yards; No. 3, 169 yards; No. 4, 193 yards, No. 5, 135 yards.

The Cromford and High Peak Railway.—The application of the locomotive engine to the purposes of railway transit on this line, was made about a fortnight since, several of the proprietors accompanying the engine. The intention is to construct, as speedily as possible, two more engines to work the two twelve mile levels between Hopton and Buxton, at a rate of from ten to twelve miles per hour, so as to enable the Company to transport goods and passengers to Whalley Bridge in a few hours, instead of two days, which it now usually takes.—*Sheffield Iris.*

The Taff Vale Railway.—The operations for finishing the line are going on with great vigour, particularly at the Merthyr Terminus, where a great number of men, carpenters, masons, and labourers, are at present busily employed. The damage caused by the late sudden rise in the river, has, we are glad to hear, been greatly overstated, as a comparatively small sum will suffice to repair it. A wall is now building on the bank of the river, which will be built so strong as to prevent the recurrence of a like calamity, and the void caused by the earth having been carried away is now being filled up.—*Monmouth Gazette.*

Great North of England Railway.—Mr. Storey has resigned the office of Engineer-in-chief, who has been succeeded by Mr. Robert Stephenson.

ENGINEERING WORKS.

Crown Point Bridge.—The Commissioners of the Crown Point Bridge and Roads met at the Court-house, in Leeds, on Monday the 15th ult., for the purpose of letting the works of this bridge, when tenders were received from many highly respectable contractors, and the competition was, we are informed, exceedingly close. The bridge is to be thrown over the river Aire, a little above the Nether Mills Weir, or from Chadwick's dye-houses on the south side (part of which will have to be removed in order to make way for it), to Medley's Oil Mill on the north side; and when the roads to and from its site are completed, it will open out a direct communication from Hunslet-lane and the southern parts of the town to York-street and the northern and eastern district of the town. The design for the iron bridge, prepared by Messrs. George Leather and Son, the engineers, of this town, is one of the most tasteful and elegant we have ever seen, combining in a remarkable degree symmetry and lightness with strength. The bridge will be of one arch, including in its span the whole width of the river and the towing path on its side. The span will be 120 feet, (that of Victoria bridge being only 80 feet), the rise of the arch 12 feet, but the height, from the water of the river to the waterside, of the arch at the crown will be 17 feet, and to the roadway of the bridge about 22 feet. The width within the parapets will be 42 feet; there being a Macadamized carriage way of 10 yards wide, with a footpath or causeway of two yards wide on each side. The arch upon which the road is to be constructed will be entirely of iron; the abutments and wing walls will be of stone. The total weight of iron is estimated at about 420 tons. The masonry was let to Messrs. Bray and Duckett, who have executed works in a very creditable and satisfactory manner on the North Midland Railway, and who are also contractors for the works now in progress for the Leeds Waterworks Company, on Woodhouse Moor. The ironwork was let to Messrs. Booth and Co., of Park Ironworks, Sheffield, who are also a firm of the first respectability. The sum at which the bridge let for was, we understand, £8,750, being somewhat lower than the estimate of the engineers, so that the commissioners have every reason to consider the bridge favourably let, not only as regards the respectability of the contracting parties, but also as regards the terms on which it was taken. The work will be commenced forthwith, and the terms of the contracts are such as to ensure its being carried forward with vigour; and it is confidently anticipated that this bridge may be opened for the use of the public at the close of the present year.—*Leeds Mercury.*

Portsmouth Harbour.—A most complete survey of the Portsmouth Harbour, with its various lakes and approaches, has recently been made by Lieuts. Sherringham and Otter, and their assistants, including a minute map of the towns. The most extraordinary coincidence exists, we understand, between the present survey, with all the improved methods, and still more improved instruments, and the old survey of Mackenzie, made in 1782, and the still more recent one of the late talented and industrious Mr. Park, who was then Master Attendant here; and, still more extraordinary, the soundings, all over, have varied only in the slightest degree in the period alluded to, 60 years. The bar off the Southsea land-marks remains unaltered from its shape and size as recorded in the oldest minutes; and we find it consists of no shifting matter, but is a firm substance of flint and chalk, almost concreted together with gravel; it could be channelled with much ease, but with some expense.

The Shannon Improvement.—Two steam dredging machines have commenced operations on the shoals of the river near Banagher. One of the machines it is stated, removed 38 tons of clay intermixed with gravel in 20 minutes. Besides the dredging operation, works have been contracted for at Killaloe, Meeleck, Banagher, and Athlone.

An Iron Bridge has been constructed at Nantes, on the same principle as that adopted by M. Polonceau, on the Pont du Caroussel, drawings of which and a description will be found in the 2nd volume of the Journal. The bridge of Nantes is of one arch, about 66 feet span, and the width of the roadway 40 feet.

MISCELLANEA.

Artificial Staining of Marble.—This art was practised by the ancients, and is described by Zosimus: it is now making considerable advance at Verona. The results are as follows:—A solution of nitrate of silver penetrates the marble, and communicates a deep red colour to it. A solution of nitrate of gold penetrates less deeply, and communicates a beautiful purple violet colour. Verdigrise sinks to the depth of a line into the marble, and gives it a fine green colour. A solution of dragon's blood communicates a beautiful red colour, and gamboge a yellow tint. To apply these two colours, it is necessary to polish the marble with a pumice stone, to dissolve the gum resins in hot alcohol, and put them on with a camel-hair pencil. The tinctures obtained from woods, as Brazil wood, logwood, &c., penetrate deeply into marble. Tincture of cochineal, with the addition of a little alum, gives marble a fine scarlet colour, similar to African marble. Artificial orpiment produces, when dissolved in ammonia, a lively yellow colour. If verdigrise be boiled with white wax, and the mixture be applied to the marble, and then removed when it has cooled, it will be to have penetrated five lines, and to have produced a fine emerald colour. When it is wished to apply the different colours in succession, some precautions are necessary. The tinctures prepared by spirit of wine and by the oil of turpentine are to be applied to the marble while it is hot; but the dragon's blood and gamboge are to be used with the marble when cold. For this purpose, it is necessary to dissolve them in alcohol, and employ the solution of gamboge first. This, which is clear, soon becomes turbid, and affords a yellow precipitate. Those parts of the marble which are covered with the tincture are then to be heated, by passing over them, at the distance of half an inch, a red-hot iron plate, or a charcoal chauffer; it is then allowed to cool, and the iron is to be again passed over those portions where the colour has not penetrated. When the yellow colour has been imbibed, a solution of dragon's blood is to be applied in the same manner; and, while the marble is hot, the other vegetable colourt may be communicated. The last colours to be applied are those in union with the wax. These must be used with great caution, because the slightest excess of heat causes them to penetrate deeper than is necessary, which renders them less adapted for delicate work. During the operation, cold water should be occasionally thrown upon them.—*Athenæum.*

Height of Waves.—The highest wave which struck the French ship *Venus*, during her voyage, was 7·5 mètres (23 feet); the longest wave was met with in the south of New Holland, and was three times the length of the frigate, or 150 mètres (492 feet).

The quantity of Air necessary for the Healthful Respiration of the Horse.—The Committee of the Academy of Paris, to whom this question was referred by the Minister of War, have reported, that in a building where the air is properly renewed, and that result is effected by a skilful and efficient system of ventilation, a horse can never suffer, so long as he has from 25 to 30 cubic mètres of air.

A new method of nailing deck plank has been adopted in the upper deck of the Driver steamer, the invention of Mr. Blake, by which the expense of copper or composition nails in the deck may be saved, simply by punching the nails down one inch, and filling the hole with a circular plug dipped in white lead.

Reflecting Telescope.—Unfortunately Sir William Herschel never made public the means by which he succeeded in giving such gigantic development to this telescope, and the construction of a large reflector is still a perilous adventure. According, however, to a report by Dr. Robinson to the Irish Academy, Lord Oxmantown has overcome the difficulty, and carried to an extent, which even Herschel himself did not venture to contemplate, the illuminating power of this telescope, along with a sharpness of definition little inferior to that of the achromatic: and it is scarcely possible, he observes, to preserve the necessary sobriety of language in speaking of the moon's appearance with this instrument, which Dr. Robinson believes to be the most powerful ever constructed. However, any question about this optical pre-eminence is likely soon to be decided, for Lord Oxmantown is about to construct a telescope of six feet aperture, and fifty feet focus, mounted in the meridian, but with a range of about half an hour on each side of it.

Hotel de Trémouille.—All who take an interest in Parisian antiquities, may be glad to know, that the demolition of the Hôtel de Trémouille, in the Rue des Bourdonnais, is not to include that of the beautiful little tower which forms the conspicuous ornament of its principal court. The proprietors have presented this fine relic of the architecture of the 13th century to the city,—and it is about to be transported to the Museum of Historical Monuments.

Head of the Laocoon.—The following statement has appeared in the French papers, and is professedly contained in a letter from M. Valmore, an artist at Brussels—"In the gallery of the Duke d'Aremburg there are many things which are not known to any but the initiated. Among them is *the original head of the Laocoon*. This fine group, when first discovered in Italy, was," as is generally known, "without the head of the father, and an arm of one of the sons. The head was supplied by a celebrated artist, who copied it from an antique bas relief. Some time afterwards, the original was found by some Venetian connoisseurs, and was ultimately sold to the grandfather of the Prince for about 160,000 francs, and brought to Brussels. When Napoleon, during the Consulate, had the group transported into France, he knew that the real head was in possession of the Duke, and offered him his weight in gold for it. This was refused; and as it was known that Napoleon was not scupulous in gratifying his desires, the Duke d'Aremberg sent this *chef-d'œuvre* to Dresden, where it remained concealed for ten years, but was brought back again into Brussels, when Belgium became tranquil. It expresses, in the highest and most admirable degree, moral grief mingled with physical pain. The compression of the teeth and contraction of the lower jaw are almost too horrifying to be long contemplated; and yet in this intense expression of suffering there is not the slightest grimace. The pupils of

the eyes are so exquisitely executed, that they actually seem to flash from the marble (!) A cast from the head now on the statue is placed by the side of the original, and the vast difference between the two is at once evident."

Busts of Engineers. Mr. C. A. Rivers, the sculptor, has just completed a very pretty cabinet bust of Smeaton, modelled in wax from the portrait lately presented to the Institute by Mr. Burges. He has also executed on the same scale, busts of Watt, Telford, Perkins, the elder Brunel, and Huddart, several of which our readers must have seen in the Adelaide and Polytechnic Galleries.

A Society of Architects has been formed in Paris, having as its "leading object, to unite with a common circle those architects who present the necessary guarantee, and to study questions of art and practise, viewed principally with relation to public and private interest."

Cornwall.—A new Episcopal Chapel is now erecting at Flushing, in the parish of Mylor, The building is constructed from the designs, and under the superintendence of Mr. Wightwick, of Plymouth. It is in the Anglo-Norman style, and calculated to accommodate 250 sitters, without reckoning the gallery, which it is not proposed in the first instance to erect. Lord Clinton is the chief private subscriber, and the London Incorporated and Local Diocesan Societies, have afforded also liberal assistance.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 30TH JANUARY, TO 23RD FEBRUARY, 1841.

Six Months allowed for Enrolment.

CHARLES SCHAFHAUTL, of Swansea, Doctor of Medicine, EDWARD OLIVER MANBY, and JOHN MANBY, of Parliament Street, Civil Engineers, for "*improvements in the construction of puddling, balling, and other sorts of reverberatory furnaces, for the purpose of enabling anthracite, stone coal or culm to be used therein as fuel.*"—Jan. 30.

JAMES MACLELLAN, of Glasgow, Manufacturer, for "*an improved combination of materials for umbrella and parasol cloth.*"—Jan. 30.

EZRA JENKS COATES, of Bread Street, Cheapside, Merchant, for "*improvements in the forging bolts, spikes, and nails.*" Communicated by a foreigner.—Jan. 30.

HENRY PAPE, of Great Portland Street, Piano Forte Manufacturer, for "*improvements in castors.*"—Feb. 1.

CHARLES HOOD, of Earl Street, Blackfriars, Iron Merchant, for "*improvements in giving signals.*"—Feb. 1.

WILLIAM WILKINSON TAYLOR, of Barrowfield House, Essex, Gentleman, for "*improvements in buffing apparatus for railway purposes.*"—Feb. 1.

DOMINIC FRICH ALBERT, of Cadishead, Manchester, L.L.D., for "*an improved or new combination of materials and processes in the manufacture of fuel.*"—Feb. 1.

FRANCIS SLEDDON, jun., of Preston, Machine Maker, for "*improvements in machinery or apparatus for roving, slubbing, and spinning cotton and other fibrous substances.*"—Feb. 2.

WILLIAM WARD ANDREWS, of Wolverhampton, Iron-monger, for "*improved methods of raising and lowering windows and window blinds, and opening and shutting doors, which are also applicable to the raising and lowering of maps, curtains, and other articles.*"—Feb. 2.

THOMAS YOUNG, of Queen Street, London, Merchant, for "*improvements in furnaces or fire places for the better consuming of fuel.*"—Feb. 3.

WILLIAM HANCOCK, jun., of King Square, Middlesex, Accountant, for "*an improved description of fabric suitable for making friction gloves, horse-brushes, and other articles requiring rough surfaces.*"—Feb. 3.

JOSEPH BUNNETT, of Deptford, Engineer, for "*certain improvements in locomotive engines and carriages.*"—Feb. 3.

JOHN CARTWRIGHT, of Loughborough, Manufacturer of Hosiery, HENRY WARNER, of the same place, Manufacturer of Hosiery, and JOSEPH HAYWOOD, of the same place, Frame, Smith, for "*improvements upon machinery commonly called stocking frames or frame work knitting machinery.*"—Feb. 4.

THOMAS GRIFFITHS, of Birmingham, Tin Plate Worker, for "*improvements in such dish covers as are made with iron covered with tin.*"—Feb. 8.

JAMES THORBURN, of Manchester, Mechanist, for "*certain improvements in machinery for producing knitting fabrics.*"—Feb. 8.

WILLIAM RYDER, of Bolton, Lancaster, Roller and Spindle Maker, for "*improved apparatus for forging, drawing, moulding, or forming spindles, rollers, bolts, and various other like articles in metals.*"—Feb. 8.

THOMAS FULLER, of Salford, Machine Maker, for "*improvements in machinery or apparatus for combing or preparing wool or other fibrous substances.*" Partly communicated by a foreigner.—Feb. 8.

ELISHA OLDHAM, of Cricklade, Wilts, Railroad Contractor, for "*improvements in the construction of turning tables to be used on railways.*"—Feb. 8.

CHARLES GREEN, of Birmingham, Gold Plater, for "*improvements in the manufacture of brass and copper tubes.*"—Feb. 8.

WILLIAM WIGSTON, of Salford, Engineer, for "*a new apparatus, for the purpose of conveying signals or telegraphic communications.*"—Feb. 8.

JOSEPH SCOTT, of Great Bowden, near Market Harborough, Timber Merchant, for "*improvements in constructing railways, and in propelling carriages thereon, which improvements are applicable to raising and lowering weights.*" Feb. 8.

JAMES JOHNSTONE, of Willow Park, Greenock, Esquire, for "*improvements in motive power.*"—Feb. 8.

WILLIAM HENRY FOX TALBOT, of Locock Abbey, Wilts, Esquire, for "*improvements in obtaining pictures or representations of objects.*"—Feb. 8.

WILLIAM EDWARD NEWTON, of Chancery Lane, Mechanical Draughtsman, for "*improvements in obtaining a concentrated extract of hops, which the inventor denominates 'humuline.'*" Communicated by a foreigner."—Feb. 8.

THEOPHILUS SMITH, of Attleborough, Farmer, for "*improvements in ploughs.*"—Feb. 15.

JAMES WHITELAW and GEORGE WHITELAW, Engineers, of Glasgow, for "*a new mode of propelling vessels through the water, with certain improvements on the steam engine when used in connexion therewith, part of which improvements are applicable to other purposes.*"—Feb. 15.

PHILIP WILLIAM PHILLIPS, of Clarence Place, Bristol, Gentleman, &, WILLIAM BISHOP BECK, of Broad Street, Bristol, Wine Merchant, for "*improvements in four wheeled carriages.*"—Feb. 15.

JAMES RANSOME, and CHARLES MAY, of Ipswich, Machine Makers, for "*improvements in the manufacture of railmay chairs, railway or other pins or bolts, and in wood fastenings, and trenails.*"—Feb. 15.

WILLIAM SCAMP, of Charlton Terrace, Woolwich, Surveyor, for "*an application of machinery to steam vessels, for the removal of sand, mud, [illegible], and other matters from the sea, rivers, docks, harbours, and other bodies of water.*"—Feb. 16.

WILLIAM SAMUEL HENSON, of Allen Street, Lambeth, Engineer, for "*improvements in steam engines.*"—Feb. 16.

GEORGE EDWARD NOONE, of Hampstead, Civil Engineer, for "*improvements in dry gas meters.*"—Feb. 18.

WILLIAM ORME, of Stourbridge, Ironmaster, for "*improvements in the manufacture of coffered spades, and other coffered tools.*"—Feb. 18.

JOHN COLLARD DRAKE, of Elmtree Road, Saint John's Wood, Land Surveyor, for "*improvements in scales used in drawing, and laying down plans.*"—Feb. 18.

ANTHONY BERNHARD VON RATHEN, of Kingston-upon-Hull, Engineer, for "*improvement in fire grates, and in parts connected therewith, for furnaces for heating fluids.*"—Feb. 22. (Four months.)

WILLIAM NEWTON, of Chancery Lane, Middlesex, Civil Engineer, for "*improvements in the process of and apparatus for purifying and disinfecting greasy and oily substance, or matters both animal and vegetable.*" Communicated by a foreigner.—Feb. 22.

THOMAS WILLIAM BOOKER, of Merlin, Griffiths Works, near Cardiff, Ironmaster, for "*improvements in the manufacture of iron.*"—Feb. 22.

JONATHAN GUY DASHWOOD, of Ryde, Isle of Wight, Plumber, for "*improvements in pumps.*"—Feb. 22.

MOSES POOLE, of Lincoln's Inn, Gentleman, for "*improvements in tanning, and dressing, or currying skins.*" Communicated by a foreigner.—Feb. 22.

CHARLES SNEATH, of Nottingham, Lace Manufacturer, for "*improvements in machinery, for making or manufacturing of stockings or other kinds of loop work.*"—Feb. 23.

JOHN DEAN, of Dover, Chemist, for "*improvements in preparing skins and other animal substances, for obtaining gelatine, size, and glue, and in preparing skins for tanning.*"—Feb. 23.

TO CORRESPONDENTS.

A. Q. Z. *We cannot give the description he requires, it has already appeared in several publications.*

G. H. S. *The rules he requires we shall publish at some future opportunity, but not at present.*

Mr. Hance's *communication will be noticed next month.*

The Wesleyan Centenary Hall and Mission House next month.

An Old Subscriber *will feel obliged if any of our readers can inform him, the process of printing Transparent Window Blinds.*

Communications are requested to be addressed to "The Editor of the Civil Engineers ane Architect's Journal," *No.* 11, *Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

ERRATUM.

At page 88, line four from the top of the first column, for "In all *our* architectural drawings," read "In all *old* architectural drawings."

NOTES RELATIVE TO TOWING PATHS AND BANKS OF CANALS IN GREAT BRITAIN.

By M. Vuigner, Inspector of the Paris Canals.

(With an Engraving, Plate IV.)

(Translated from the French.)

M. Vuigner, being commissioned by the company of the Ourcq and St. Denis canals to study the various systems of works in use on the British canals, and particularly to examine the different methods used in forming the foundations of the hauling or towing paths, and protecting the slopes of the interior banks from the effects produced by the ordinary and irregular fluctuations of the water, he visited, for this purpose, in the course of 1837, the canals of that country, which stand the first in construction, and collected considerable information on the subject.

In England the canals of Taunton & Bristol, those of Birmingham, (from Liverpool to Leeds) Preston & Lancaster, in Scotland those of Paisley or Ardrossan, the Forth and Clyde, and the Union Canals, furnished him with every information that could be required. On his return to France, the company, who wished to establish on the Ourcq canal a set of passage boats, empowered M. Vuigner immediately to apply the information he had acquired. He was first engaged to macadamize the towing path of the left bank of the Ourcq canal between LaVillette and Meaux, and caused part of its banks to be improved, and he also applied some improvements resulting from his observations in Great Britain.

The present paper will contain a description relative to the *metalling* of the towing paths, and the protecting of the banks on the English and Scotch canals, as well as describing the macadamizing and facing used on the Ourcq canal to prevent damage by the action of the water.

Towing or Hauling Paths.

In England there is generally only one towing path, though, upon some new lines, especially the Birmingham, there are two paths. This is an exception which a particular circumstance required, but which, however, is not a deviation from the general rule. The Birmingham has a towing path on both sides until it is divided into two branches, one to Wolverhampton, and the other to Walsall, each having their towing paths, one on the right side and the other on the left. On that part where there is a towing path on each bank, the navigation is extremely active, amounting to more than 1000 boats per week. The navigation is facilitated, and at the same time the horses that tow the boats coming from Wolverhampton and Walsall have not to change their sides, nor obstruct one another. The breadth of the towing paths is generally not more than 10 feet, which is considerably less on some canals, and especially at Taunton, a canal of very small section, navigated by boats of only 10 tons.

On the new line of the Birmingham canal, the breadth of the towing path in cuttings is about 12 feet, and on embankments 15 feet. The path is generally divided into three parts, one part next the canal forms a fender or raised mound 1 ft. 6 in. to 2 feet wide, which is turfed over, the middle part forms the trackway for the horses, and is covered with metalling or broken stone to the width of five or six feet, and the other part is the remainder of the land unappropriated; sometimes it contains a drain for carrying off the surface water, and is enclosed with a hedge which determines the limit of the canal property. On the opposite bank, there is, in some parts, a footpath about 3 feet wide, but more frequently the underwood or cultivated land reaches to the water's edge, so that no more land is taken than what is absolutely necessary for the canal.

On the Preston, Lancaster, Paisley, Forth & Clyde, and Union Canals, where there are fast passage-boats, the width reserved for the fender between the towing path and the interior slope of the canal, is on the average two feet wide at the base, and raised from 6 to 8 inches above the path, or from 2 ft. to 2 ft. 6 in. above the surface of the water, the top, about 1 ft. to 1 ft. 4 in. wide, is generally turfed over. The interior edge forms the continuation of the interior slope of the canal, and the outer edge is sloped and protected with large round pebbles placed at intervals of 2 to 3 feet, which are partly imbedded in the earth, and project about 2 inches above the fender; these pebbles are now abandoned, as they were found inconvenient for the towing ropes when the speed was slackened. On some parts of the canals the fender is formed of flat stones, the edge of which forms the top of the stone facing of the bank, as shown in sections, Figs. 17, 18, and 19. The fenders answer the purpose for limiting the track of the horse, preventing the mud being washed over the path, and a protection to the edge of the slope.

The towing path of the above canals is mostly formed of a layer of broken or round pebbles laid to a thickness of 4 to 6 inches according to the nature of the soil, and then covered with a layer of gravel from 1 in. to 1½ in. thick. On some parts marly clay is used to bind the pebbles, and on other parts, especially at the stopping places, at the bridges, and even the whole length of the Paisley canal, the pebbles are covered with a layer of iron slag, which, when well beaten in, forms a path extremely hard and compact, besides, it is not slippery in rainy weather, and is free from dust in summer. The broken pebbles used are generally not larger than 1½ inch at most. The best macadamized paths are those made of broken limestone, and better still with basalt; these materials are found nearly every where on the banks of canals, which renders their formation and repair very cheap.

The transverse slopes of the towing path, where there are fast passage boats, have an inclination of about 2 inches to the yard declining from the canal; this inclination is found to give the best hold for the horses' feet. The surface water is carried off on the outside of the path, and is seldom allowed to run into the canal, excepting in such parts where the canal is formed in cutting; it is then carried off by under drains of dry stones, which pass under the towing path transversely from longitudinal gutters or drains, formed on the outside of the path.

Towing Paths of L'Ourcq Canal.

The towing paths of this canal, and in general on all the French canals were formed on the natural soil, without the least metalling or stoning of any sort; in winter time they were quite impassable in parts, especially in the Paris division, between La Villette and Claye. In this state of things it was difficult to think seriously of establishing passage boats, which the Ourcq and St. Denis canal company was desirous of introducing into France; they therefore determined upon adopting the English system of macadamizing the towing path of the left bank of the Ourcq canal between La Villette and Meaux. On the Ourcq canal the ordinary boats are towed up by one horse; but the passage boats, as well as the Government boats, are towed by two horses abreast, as well going up as down, which is still the case. The experiments which were made on the speed of passage boats, showed that three horses, two horses abreast in front and one behind, were necessary for towing these boats. It thus became necessary to increase the width of the towing path. In those places where the banks had retained their first form the breadth of the path was 13 ft., which was diminished to 11 ft. 6 in., where the banks were raised 1 ft. 6 in. above the surface of the water. The towing path is now reduced throughout to a breadth of 9 ft. 6 in., consisting of a fender 2 ft. wide at the base, the trackway for the horses 6 ft. 6 in. wide, and a drain 13 inches wide. In the Meaux division they have only allowed a breadth of 6 feet for the towing path, but the drain has been increased to 19 inches wide, which still gives a breadth of near 8 feet upon which the horses can walk or run with ease. This breadth might be considered insufficient at the points of crossing, where four horses have to pass; but the company decided that in case that should occur, they would cause the front horses to be harnessed one before the other. Another important consideration which determined the company to adhere to 9 ft. 6 in. was that of economy, as it would involve an extension of the work for more than 30 miles between La Villette and Meaux, and double that distance if extended between La Villette and Mareuil.

Experience has proved that the adopted width is sufficient for the different boats, as the horses of the passage boats in general never pass each other, excepting at the different stages, where the path is widened. As regards the horses of the other boats when they pass, the horses go a little on one side, or on to the exterior slopes, and if it be found too inconvenient to act thus, it is immediately obviated by harnessing the horses one before the other as before observed.

The breadth being settled, it then became necessary to fix the height of the towing path above the surface of the water. Between La Villette and Meaux the top of the interior slope was 8 ft. above the bottom, but between La Villette and Claye it was only 6 ft. 6, and from Meaux to Claye 5 feet, so that the same height of path could not be adopted throughout. Between La Villette and Meaux the height of the fender was fixed at 2 ft. 6 in. above the surface of the water, and 6 inches above the towing path, which made the latter 2 feet above the water, as shown in sections, Figs. 5, 7, & 14.

The paths were formed in some places with broken limestone, in other places with clean pebbles mixed with sand or coarse gravel, and laid to a thickness of 4 to 5 inches, and covered with a layer of gravelly sand from 1 in. to 1½ in. thick; the pebbles, when mixed with coarse gravel, were used without an extra coat, and laid to a thickness of 6 inches. As soon as the paths were finished, a roller 5 feet broad,

line of large boats across the river, he made use of them as a coffer-dam or breakwater, and under the shelter of them, passed over the troops in canoes, and swam over the horses, which were guided along-side of the vessels by men stationed on board of them.

At New Carthage (Carthagena) in Spain, one of their principal colonies, we again find traces of their engineering works, between the lake and the sea they cut a narrow navigable canal, and across this there was a bridge used by carriages and beasts of burden. In the city, one of the hills was dedicated to Aletes, who is said to have obtained divine honours, from having first discovered the silver mines, which were extensively wrought by the Carthaginians in Spain.

GREEK ENGINEERING—BRIDGES—PHŒNICE—PSOPHIS.

In Epirus we find mention of a bridge, which seems to have been after the fashion of that at Babylon, mentioned in our first article, and to have been of a class common among the ancients. This was at Phœnice, and had piers of stone with moveable planks laid upon it. At Psophis in Arcadia a bridge is mentioned over the Erymanthus, a great and rapid stream.

CAUSEWAY—AMBRACUS.

Ambracus in Etolia is described as a fortress of considerable strength situated in the middle of a marsh, and secured by a wall and outworks it was only to be approached by one narrow causeway. It was be-sieged and taken by Philip king of Macedonia, who carried causeways through the marsh.

SIZE OF FORTS.

Speaking of Tichos, a fortress near Patræ, Polybius says that it was of no great size, being not more than a stadium and a half in circum-ference, so that it might have sides of eighty yards in length.

ENGINEERS.

Among the supplies furnished by the Rhodians to the Sinopeans in their war against Mithridates,* engineers are mentioned, and military engines.

REBUILDING OF RHODES.

On the destruction of Rhodes by an earthquake, large supplies were sent by the allies of that city in order to enable them to rebuild it. Among these supplies Ptolemy, king of Egypt, sent forty thousand cubits of square pieces of fir; a hundred architects, and three hundred and fifty labourers. Antigonus sent them ten thousand pieces of tim-ber, that was proper to be cut into solid blocks from eight to sixteen cubits; five thousand planks of seven cubits; three thousand weight of iron. Seleucus his father sent ten thousand cubits of timber.—Other parties sent in the same proportion.

Building materials seem to have been considered as of great value, for in case of the sacking of towns the timber and tiles were frequently carried off.

* Polybius book 4, chap. 5.

EPISODES OF PLAN.

(Continued from page 74.)

ALTHOUGH they may seem to betray a consciousness of the weak-ness of our cause, upon the principle of *qui excuse, accuse*, we have con-sidered the preceding remarks necessary, in order to combat the opposition which the system we would recommend is likely to encoun-ter. But it would be a positive weakness on our part, were we to assume a deprecatory and apologetic tone, as if we had misgivings of our own, and accordingly threw ourselves entirely upon the indulgence of our readers, for presuming to bring forward what its novelty alone may be thought to condemn. The starting matters altogether so new is in itself an act of presumption, if merely because it is a tacit re-proach upon the indolence, the indifference, or ignorant carelessness of those, who, having had the opportunity, have never touched upon, or called attention to them; consequently sinning as we do to that extent, we may dispense with what would be as troublesome to ourselves, and as impertinent towards our readers, as it would be useless—namely, any affectation of modesty.

Be it said that opportunities for applying any striking combinations of plan, even in the way of episodical parts in a building, are of rare occurrence, that ought to be a *raison de plus* wherefore every thing like an opportunity should be eagerly caught at, and turned to the ut-most account. So far from which being the case, it appears to be especially shunned. There are some hundreds of seats and residences throughout the country, from which, putting them all together, hardly half a dozen fresh ideas are to be obtained. That they may be "goodly houses,"—well built, and containing well proportioned, expensively and luxuriously furnished rooms, is not denied. Their plans may be perfectly unexceptionable as regards comfort and convenience,—free from aught amounting to a fault, or even to a blemish, nevertheless as insipid and uninteresting as possible. Look at the majority of the plans given in Richardson's Vitruvius Britannicus,—which, it may be presumed, are rather above than under the average: do they offer a single happy architectural point worth studying? Yet in houses of the class there shown, some merit of that kind might reasonably enough be expected. The chief lesson to be derived from them is that both their employers and architects themselves are satisfied with the very first ideas that come *to hand*—and the hand seems to have more to do with such matters, than the mind. Exceptions, it is true, are to be found; yet they are merely the *rari nantes in gurgite vasto*;—which circumstance, however, much as it is to be regretted in itself, has its convenience, because all the examples of that kind might be collected together within a moderate compass; and it has frequently struck us as rather singular that no one should hitherto have brought out a pub-lication devoted entirely to a series of studies of interior architecture, elucidated not only by plans and sections, but perspective views also, for the purpose of showing effects. Of course we would have only the very cream served up, without a particle of that "thrice skimmed sky-blue," which architectural caterers are too much in the habit of imposing upon their customers.

Were it properly got up, some such work as what we have just pointed out, would be found eminently instructive, particularly if ac-companied by *pentimenti and variations* of the plans (in wood-cuts), showing the same general ideas differently modified. It is true, some-thing of the kind may even now be picked up out of architectural pub-lications; but then it is not from such as are to be met with in a mode-rate collection, or as are likely to fall in the way of students. Neither are such subjects satisfactorily elucidated, when they occur merely as parts of general plans and sections, in which latter far more is some-times left unexplained and doubtful, than is actually shown. It may be said, and very truly so, that the want of any work of the kind has not been felt, or else we should have had not only one, but a number of them ere now, as in all such cases supply invariably keeps pace with demand. Yet, if this cannot be disputed, it seems to us only an addi-tional proof of the utter disregard paid to the subject itself; as if any thing would do for interior architecture, and that nothing more is re-quired in the way of designing than to be able to draw the doors, chimney-piece, and cornices of the rooms in a section. An architect, it would seem, requires no instruction for designing the interior of a building, except what he can gather from his own observation and practice; positive lessons and studies for the purpose, are quite unne-cessary. There he may safely be left entirely to his own guidance; although, if such be the case, we do not see, wherefore so many finical rules should be deemed necessary for even the most trivial circum-stances in external architecture,—more especially as those petty rules are after all little better than impertinences, for those who are worthy of the name of artists are guided by something better, while those who are not, blunder on by help of rules, pretty much as they would blunder on without them. Hardly can it be said that there is less occasion for the student's directing his attention to interior arrangement and design, than to exterior architecture, there being, according to the doctrine of chances, quite as much probability that he may have at least one op-portunity of displaying his taste and ability in planning and decorating a moderate sized yet recherché residence, as that he will ever be called upon to erect a palace, a senate-house, a cathedral, a museum, or in short any one of those *phenixes* upon which academical students are set to work their wits before they are capable of producing a single new idea on a moderate scale.—To be sure there is less study required for producing something catching on a large scale, where the "lion's-hide" pompousness of the subject conceals the inanity and poverty of the conception.

Probably the remarks we have just made, will be considered quite irrelevant and impertinent; and that they are somewhat ungracious we admit—would to Heaven! they could be proved to be utterly un-founded and unjust!—But of introductory observation our readers have by this time had enough—more than may be altogether palatable; it be-hoves us therefore, now to come at once to our professed subject; which is, indeed, one both so new in itself, so complicated, and of such extent, as to render the task we have undertaken rather an embarras-sing one. We do not pretend, however, to treat it systematically, proceeding gradually from the simplest elements of plan, to the most varied combinations of them; but shall merely in the first instance, enumerate some of the leading circumstances by which different com-

binations may be obtained, and then exhibit some detached *Episodes*, and individual instances. Hitherto, *Plan*—by which we mean not only the outline of the floor, but that of profile and section likewise—has been allowed to exhibit scarcely any variety, effect being almost exclusively limited to that kind of it which arises from material, colour, and decoration. Accordingly if it can be shown that there are other sources of variety, it becomes evident that there is far greater scope afforded by interior architectural composition, than where novelty of design consists in nothing more than substituting one order of columns for another, or something else of that kind, without any novelty whatever in regard to arrangement, shape, and proportions in the ensemble.

Of course where a room is a simple square or parallelogram in its plan, there can be no combination; yet as soon as we proceed a step further various combinations may be obtained. Still we choose to limit ourselves in nearly every case to the simplest and first step; for if it be required to give rather more than ordinary architectural character to a room, it is usually done by putting two columns towards each end, so as to divide it into three compartments; and that being done we seem to have fairly got *au bout de nôtre Latin*. Let us, then, take no more than a triple arrangement of plan, and show some of the combinations that may be obtained from it, distinguishing the divisions of the plan by the terms Centre and Ends; and it will be less troublesome to ourselves, and more intelligible to our readers, if we give them in the form of a mere list. First then, in regard to plan, we have the following varieties:—

Centre and Ends all rectangular, equal in breadth, and differing only in their relative proportions.
Centre wider than Ends.
Centre narrower than Ends, or the Ends *expanded*.
Centre rectangular, Ends semicircular or curvilinear.
Centre circular or polygonal, Ends rectangular.
Centre a square or parallelogram, Ends octagonal, hexagonal or other form of polygon.

Secondly. In regard to Profile or Section:—
Centre and Ends, of uniform height and with flat ceilings.
———————— ditto arched.
Centre loftier than Ends, but with flat ceiling.
———————— and domed, or arched.
Ends loftier than Centre, and arched traversely to the latter.
———————— and domed.

Thirdly. In regard to arrangement of windows and mode of lighting:—
Centre and Ends all lighted from one side of the room.
Centre lighted from side, Ends from the extremities of the room.
Centre lighted from one side, and Ends from opposite one.
Centre lighted from side, Ends from above.
Centre lighted from above, Ends from side.
Centre and Ends all lighted from above.
Centre alone lighted, either from side or above.
Ends alone lighted, ditto.
Centre or Ends lighted not from ceiling but from windows at the sides, at a distance from the floor.

Without our extending this list any further, it will be evident that a vast number of combinations may be obtained, entirely independent of the innumerable differences arising from columns and other decoration, from dimensions and proportions, from colour and material. In fact every one of the modes above enumerated—and they are by no means all—affords as much or more scope for architectural design in other respects, than there is now by the single one which is almost invariably adhered to.

We have merely mentioned as one distinction that produced by lighting either the whole room, or one or more of its divisions from the ceiling; but then, that, too, may be effected in a variety of different ways. The light may be admitted through glazed coffers or panels (plain, again or coloured), through a dome, or through a lantern, which last admits of almost infinite variety of form and design. Lantern lights may not only vary in their plan,—be square, oblong, circular, octagonal, &c., but be ceiled above and have windows on their sides, or closed at the sides, and have the light transmitted through the ceiling, accordingly as either the design itself, or other circumstances may dictate.

It may be said—and that not unreasonably—the kind of room we have noticed, namely, one capable of being divided into compartments, is fitted only for a gallery or library of some extent. Still there are a variety of other combinations to be effected in rooms of a different class, by merely breaking their plans, yet without exactly dividing them into distinct compartments. Dining-rooms certainly admit of great architectural character being bestowed upon them, by a sideboard alcove, by which is to be understood something more than a mere shallow or *blank* recess—as it may not improperly be termed—which where there is any thing of the kind at all, is generally the *maximum* attempted, although in itself it is exceedingly little indeed.

(To be continued.)

ESTABLISHMENT FOR PROCURING MOULDS FROM MONUMENTS OF ART.

Sir—The debate which followed Mr. Gillon's motion, cannot fail to raise the hopes of all who have the interests of taste at heart; and I hope that you will permit me, at this apparently auspicious time, to bring forward in your columns a scheme, which, although, if I may judge from the brief paragraph in a former number, does not meet your approbation in its original shape, yet if some other mode of operation can be devised, its object will, I feel convinced, have your earnest support. I allude to the formation of an establishment for procuring moulds from interesting monuments of art, and for diffusing casts from these at the cheapest possible rate, over the country.

The French have long possessed such an establishment, under the immediate patronage of government, and moulders are constantly employed in foreign countries, as well as in different parts of France, making moulds from monuments of art of every age, from the earliest times down to a late period. French moulders are to be found not only in the capital cities of Italy, but also in the ancient towns which offer so many interesting specimens of the arts of the middle ages. A few years ago, as I have already stated in a former paper, elsewhere, 14,000 dollars were spent in Florence alone, in making moulds, which were afterwards conveyed to Paris. How advantageous the results of such a system! In Paris artists of every description may find specimens of sculpture from every statue and building with which they are acquainted. Architects may at a very small cost, in addition to their libraries, form museums, containing casts from portions of the buildings, the plans and elevations of which their books contain. Engravings however perfect, can convey but a faint idea of the graces of execution in architectural sculpture, and I think that the consequences of designing from these alone are sufficiently illustrated, in our cold, spiritless, and precise ornamental details.

I wish to see some such establishment as the French one in London; the subject has excited much attention in Scotland, and when I first brought it forward it was warmly taken up by many enlightened and energetic individuals; but objections were urged against it in London, although I have not been able precisely to ascertain their nature or extent. I believe that the apprehension of the creation of a monopoly, and the consequent injury to individuals who have already invested capital in casting was the strongest objection. I should like to know, how much capital is really invested in this branch of trade, and how many individuals pursue it, and how many good moulds they possess? of this I am certain that we have repeatedly been obliged to send abroad for casts, after vainly seeking them in London. It may be observed that this is not surprising, if we demand casts from works, of which it is most unlikely that casts should exist, but this has not been the case, the casts required have in most cases been such as *ought* easily to have been found in London. Your own Schools of Design are furnished from Paris, for with the exception of casts from sculptures in the British Museum, which are of the best quality, a few from foreign monuments of a very indifferent quality, and some from our national specimens of art, nothing is to be had in London.

I would here point out that there are difficulties in the way of procuring moulds from important monuments, which are insuperable to private enterprize. Government alone for instance, could procure a new mould of the Venus de Medicis. I feel convinced that although the Grand Duke will not hear of a mould from this statue of statues, he would at once accord it, to the request of a nation preferred through the proper channel, to which he owes his possession of the gem. I have no doubt that established London sculptors would willingly give fifty guineas for a first cast from a new mould of the Venus, I have known twenty-five paid in Rome for a good cast of this statue; in this point of view it seems evident that such an establishment could not prove a very costly one to the nation, for however liberal its Directors ought to be to public galleries, and however cheap casts generally should be sold to effect the good anticipated, still first casts from rare and precious works should be disposed of to individuals on different terms. There are unquestionably numberless specimens of art of the highest value and interest, casts from which, could be procured only by government influence. I mentioned the deficiency in London of moulds from important monuments, I should imagine that the chief source of profit to your casters must proceed from their employment by living sculptors, and a National Casting Establishment whose object would

RAILWAY STATISTICS.

[The following Tables have been compiled from Mr. Whishaw's work on the Railways of Great Britain.]

Table A gives the total lengths of railways, from which it appears that of 58 railways enumerated, 1699½ miles in length, 31 (measuring 319¾ miles) are under twenty miles in length, suggesting a great waste of capital in the management.

Table B gives the lengths of 58 railways distributed as single and double lines of railway, by which it appears that not more than a sixth are single lines of railway.

Table C shows the number of miles of single and double railways laid down upon each gauge for 1756 miles of railway, with the total of miles of single railway laid down on each system, giving a total of 3217¾ miles of single railway, of which 2544 are laid down on the common gauge, and 427 miles on the broad gauge.

Table D shows the number of miles of single and double railway, the stated number of miles of railway, and the number of miles of single railway laid down with each of seven principal forms of rails, according to the classification of Mr. Whishaw.

Table E shows for 2271½ miles of single railway, the number of miles of single and double railway, the total number of miles of railway, and the number of miles of single railway, of each kind of rail, with the total weight in tons. It thus appears that rails of nearly 30 different weights are in use.

Table F shows for 2271½ miles of single railway, the number of miles of single railway of each description of rails, with the weight in tons, and the proportion per cent. of each class. From this it seems that about a quarter or 516¾ miles of single railway have rails under 50 lb. weight. The total weight of rails for 2271½ miles of single railway is 204,412 tons, and if we take the remaining portion of railways at the same average, we shall have a total of 309,604 tons of iron consumed as rails.

Table B.

Table of Lengths of Railway.

	Single.	Miles.	Double	Miles.	Total.	Miles.
5 miles and under	2	7¾	3	8¾	5	16½
10 "	5	37¼	8	58	13	95¼
15 "	3	37½	2	27	5	64½
20 "	3	48½	5	95	8	143½
25 "	1	24	3	66¾	4	90¾
30 "	—	—	2	55¾	2	55¾
35 "	1	32½	2	71	3	103½
40 "	1	36	3	116¾	4	152¾
45 "	—	—	2	87	2	87
50 "	—	—	2	96	2	96
60 "	—	—	2	110¼	2	110¼
70 "	1	61¾	1	69½	2	131¼
80 "	—	—	3	225	3	225
90 "	—	—	—	—	—	—
100 "	—	—	1	97½	1	97½
110 "	—	—	—	—	—	—
120 "	—	—	2	230	2	230
	17	285¼	41	1414¼	58	1699½

Table C.

Table of Miles of Gauge.

	Single.	Double.	Total Miles of Railway.	Total Miles of Rails.
4 feet 6	21½	20½	42	62½
4 feet 6½	10¾	—	10¾	10¾
4 feet 8½	200½	963¾	1164¼	2138
4 feet 8¾	—	91	91	182
4 feet 9	—	112	112	224
5 feet	—	51	51	102
5 feet 6	35½	—	35½	35½
6 feet 2	36	—	36	36
7 feet	—	213½	213½	427
	304¼	1451¾	1756	3217¾

Table A.

Table of Lengths of Railway.

	No.	Miles.
5 miles and under	5	16½
10 "	13	95¼
20 "	13	208
50 "	19	661¾
100 "	7	488
100 and upwards	2	230
	58	1699½

Table D.

Table of Shapes of Rails.

	Miles Single.	Miles Double.	Miles of Railway.	Miles of Single.
Single Parallel	60¼	253¼	313½	566¾
Parallel	107¼	209	316¼	525¼
Double Parallel	18¾	381¾	400½	782¼
Shallow Parallel	—	52½	52½	105
Fishbellied	82	17½	99½	117
Bridge Rail	39¼	138¾	276	690¾
Broad based T	—	56	56	112

Table E.

Table of Miles of Rails.

Lbs. per yard.	Miles Single.	Miles Double.	Miles of Railway.	Miles of Rails.	Tons Weight.
20	3	—	3	3	82
28	8	12¼	20¼	32½	242
35	32½	20	52½	72½	3980
40	4¾	—	4¾	4¾	298
42	42¾	4¼	47	51¼	3366
43	3½	—	3	3½	218
44	—	58¾	58¾	117½	8142
45	32½	26	58½	84½	5966
48	29½	—	29½	29½	2230
50	61¾	29	90¾	119¾	9420
53	36	—	36	36	2974
54¼	—	27	27	54	2580
54½	—	6¾	6¾	13½	1154
55	30½	38¾	69¼	107	9234
56	—	175½	175¾	351	30958
57	—	38¾	38¾	77½	6956
60	—	36¼	36¼	72½	6828
62	—	162¾	162¾	325½	32600
63	3¼	47¼	50½	97½	9642
64	—	38	38	76	7660
65	3½	119¾	123¼	242½	24686
68	4	—	4	4	428
70	—	9	9	18	1980
73	—	36¾	36¾	73½	8408
76	—	42½	42½	85	10114
77	—	57¾	57¾	115½	13738
84	4	—	4	4	528

Table F.

Table of Miles of Rails and Weight in Tons.

Lbs. per Yard.	Miles of Rails.	Proportion per Cent.
20	3	82
30	32½	242
40	77	4278
50	405¾	29342
60	711½	62684
70	763½	76996
80	274	32250
90	4	528
	2271½	206,402

REMARKS ON THE CENTRAL FORCES OF BODIES REVOLVING ABOUT FIXED AXES.

By Joseph Martin, M.D.

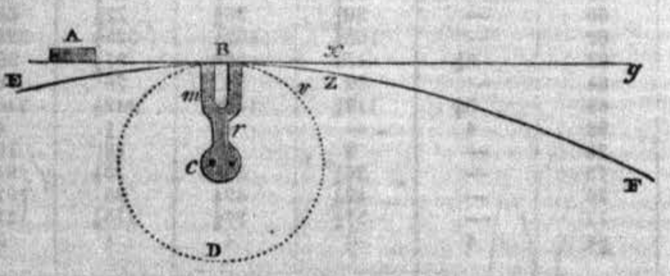
(From Silliman's American Journal.)

The theory of curvilinear motion may justly be considered one of the most important and interesting subjects connected with the physical sciences. It explains the motions of the heavenly bodies, and, by unfolding some of the grand phenomena of nature, makes them applicable to the most important and useful purposes of life. It has accordingly engaged the attention of the greatest philosophers for centuries, who have, by means of the most searching analyses, not only pointed out the slightest irregularities of those bodies which compose the great planetary system, but have discovered the causes of the seeming aberrations, and given satisfactory explanations of them. And yet it would seem that the most simple case of "central forces," the rotation of a heavy body about a fixed axis, has been in some measure neglected, or at least, treated as a subject of too little importance, either in a theoretical or practical point of view, to deserve more than a passing notice.

To explain the motions of the heavenly bodies it has been found necessary, by means of mathematical reasoning, to determine the ratio of attraction and original impulse, or projectile force, and to show the effects of their separate and combined operation. In this way the part that each of the three forces, the projectile and the central, perform in producing and preserving the motion of a planet in its orbit, is clearly defined; as well as the results that would follow if either of the last should cease to act. But the ratio of the forces which act upon a body made to revolve about a fixed axis, and the nature and extent of their separate or combined action, have not been distinctly shown. In other words, it is believed that the relative proportions of the moving power, and the forces that it produces directly and indirectly—the manner in which the central forces are excited—and the combined operation of all the forces upon a body whilst revolving and when projected, have not been satisfactorily explained.

It is not intended, however, at present to enter into an investigation of the subject upon principles purely dynamical, but the object of these remarks is to show by mathematical reasoning, founded upon experiment and familiar examples, that the power employed to revolve a body about a fixed axis is wholly expended in giving velocity to that body in the direction of the circle, and that, consequently, the central forces must be excited in obedience to a law of nature; and, in the second place, that the moving and excited forces act in conformity with the principles of "the composition of forces."

Fig. 1.



If the bar of soft iron *m*, fig. 1, be prepared as a horse-shoe magnet and secured in a proper manner to the rod *r*, working horizontally on an axle at *c*, it may be connected at pleasure with a galvanic battery, by means of its wires and the usual arrangements of cups containing quicksilver, at the centre. The iron bar A, of a suitable size and description, moving with a given uniform velocity along the straight line Ag, would be attracted at B by the magnet, if it were connected at that moment with the galvanic battery, and would be made to move in the curve B*v* of the circle BD, but in virtue of its inertia it would, in the absence of friction and atmospheric resistance, continue to move in that circle with the same uniform velocity. For the deflecting force being independent of the projectile force, and acting at all times in the direction of the radii of the circle, it cannot in any respect increase nor diminish the original velocity of the bar. And for the same reasons the force with which the bar is moving in the circle can have no influence upon the deflecting force. But a body moving in a curve or circle is always found to be acted upon by a third force, which is opposite and equal to the deflecting or centripetal force; and as there cannot be an effect without a cause, this third force must either be derived from one of those mentioned above, or their resultant—or from some other source. Supposing the circle BD, in which the bar moves, to be one foot in diameter, and the velocity of the bar to be 25·14 feet per second, or at the rate of eight entire revolutions in a second, its centrifugal velocity would be $=\frac{v^2}{2r}=\frac{25\cdot14^2}{1}=632$ feet per second, and its centrifugal force $=39$ lb. its weight being one pound, *v* representing the velocity in the circle, and *r* its radius; for if *a* be the weight of the bar, *g* equal to $32\frac{1}{12}$ feet, and *x* the force required, then $r : \frac{v^2}{g} :: a : \frac{v^2 a}{gr}=x=\frac{25\cdot14^2}{16}=39$ lb.* But the force in the circle $=\frac{25\cdot14}{16}=1\cdot55$ lb. only, consequently the centrifugal force could not have been caused by the projectile force. And it is evident that it cannot be a part of the magnetic force, for it acts in a directly opposite direction; and it is equally evident that it cannot be the resultant of the other two forces, for then its direction would be to some point within the circle. The pressure from the centre of thirty-nine pounds must therefore have originated in some other way.

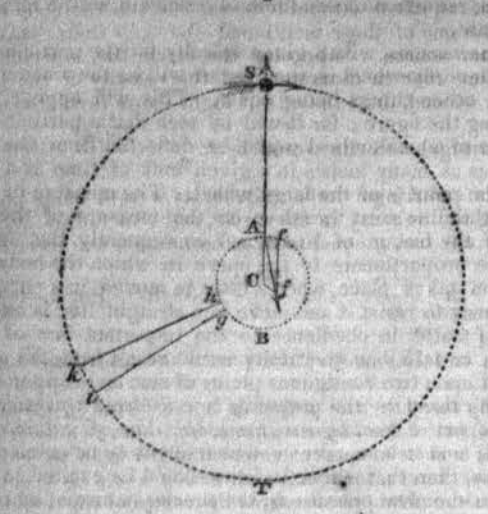
Such are the facts when the deflection from a straight line is caused by a centripetal force directed to a fixed centre of rotation, and the projectile or moving force is applied before the body is constrained to move in a circle. We will now stop the revolving rod *r*, leaving the bar A attached to *m*, by the magnetic force. If by means of a winch the same number of revolutions in a second be given to the bar that it had in the first experiment, the centripetal or magnetic force will perform the part of cohesion, and the circumstances in every other respect will be the same that would attend such a rotation if the bar were welded to *m*. Does the moving power, applied in this manner, directly produce the central force or immediately impart it to the moving body? or, in other words, is centrifugal force a part of the force employed to revolve the body? Without attempting to prove the negative of this question by minute mathematical investigations, which will be avoided as much as possible on this occasion, I will show by a reference to the familiar examples of the common sling and fly-wheel, that in a revolving body centrifugal force, whatever be its source, is much greater than the power necessary to give rotation to that body, and that it cannot therefore be directly caused by the moving power,—and then explain how it may be proved by a simple experiment.

It has been stated above that writers on dynamics have not clearly defined the operation of the laws of curvilinear motion on bodies revolving about fixed axes. One only of the many instances in which erroneous views are given by popular writers in noticing the subject of central forces, will be mentioned. In the Library of Useful Knowledge [London edition] a writer, after enumerating some of the wonderful effects produced by *accumulating force in the circumference* of a fly-wheel, remarks: "the same principle explains the force with which a stone may be projected from a sling. The thong is swung several times round by the force of the arm until a considerable portion of force is accumulated and then it (the stone) is projected with all the collected force.† By observing the facts we may discover how all this accumulation of force is produced by the strength of the arm. A stone, S, fig. 2, weighing one pound, secured to the end of a string rather less than two feet long, may be whirled in a circle of four feet diameter at the rate of two entire revolutions in a second. It is done by turning the hand in a small circle AB, about a moving axis of rotation. The velocity in the large circle $=12\cdot57\times2=25\cdot14$ feet per second; and, as shown above, if S represent the weight of the stone, *v* its velocity, *r* the radius of the circle and *x* the centrifugal velocity, then $r : \frac{v^2}{64} :: S : \frac{v^2 s}{32r}=x=\frac{25\cdot14^2}{32\times2}=9\cdot87$ pounds. The velocity in the circle being 25·14 its force in that direction is equal to 1·58 lb.;‡ and if we add 1·42 lb. for the weight of the stone and atmospheric resistance, which is more than sufficient, we have three pounds as the force with which it is impelled in the circle ST. To enable him to move the stone in the circle the operator has to *resist a force nearly equal to ten pounds, which urges his hand from the centre at every instant*

* Hutton's Mathematical Dictionary, and Gregory's Mechanics.
† Vol. I. p. 51, Art. Mechanics.
‡ Cavallo's Philosophy p 66.

R

Fig. 2.

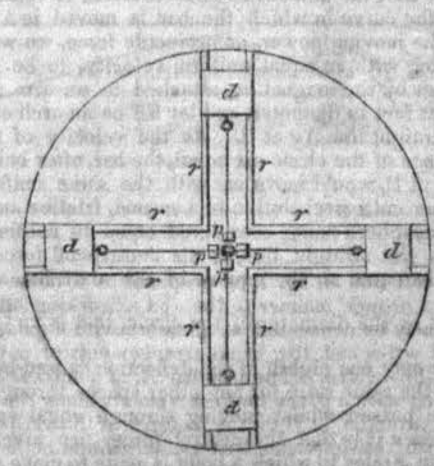


of time. He must therefore exert his strength at A in the direction of the resultant of the two forces with an effort which is equal in amount to their mechanical equivalent. If we make Ae and Ac in length proportionate to the forces 3 and 10 respectively, then the diagonal Af of the parallelogram Aefc, will show the direction in which he draws at the string, and $\sqrt{10^2+3^2} = 10{\cdot}44$ lb. will be the amount of force necessary to give the required velocity; of which, as shown above, two-thirds are expended in retaining the stone in the circle. Now it would be about as easy to show that a man can draw at a flexible cord secured to a stationary object with a force equal to 10 pounds, and at the same time press against that object, *by means of the cord,* with a force equal to six pounds, as to prove that the centrifugal force in this case is the immediate effect of the moving power. The man moves his hand in a small circle and pulls at a stone, nearly in the direction of the string to which it is attached, with a force equal to six times the weight of the stone, and yet, according to the popular belief, he not only imparts directly to it all the force with which it is projected, but dashes it off at right angles to the thong, as if it were moved at the end of a lever.

The thong of the sling, from what is said above, may be considered as in the place of an inflexible rod, the hand resisting the pressure that would act as a strain upon an axle at *c*; and if such a rod had a handle at A, the same effect might be produced. But it would cause great friction and strain upon the axle, and to obviate those difficulties, we will consider the circle ST as passing through the centre of the rim of a fly-wheel connected by arms with the small circle AB, representing a nave working on an axle at *c*. If the rim be supposed to weigh 150 lb. it might easily be revolved at the rate of two entire revolutions in a second by a handle at A, which is four inches from the centre, or so considered for illustration. When the winch A is moved about the axis, the force may be considered as acting by repeated slight impulses, as if it were applied at right angles to the radius of the circle, at each instant of time along the side of a polygon with an infinite number of sides, drawn within the circle. If the sides of the polygon be one hundred in number, they would be one fourth of an inch long, and then one and a half inches in the larger circle ST, will be the length of each side of a polygon along which the centre particles of the rim may be supposed to move. As the proportion of the circle ST is to AB as six is to unit, a moving power acting on the latter at the winch A, with a given force, through *g*, *h*, one fourth of an inch, will move the rim through *i*, *k*, equal to six times that space, with one sixth of the force applied; but as *the moment of rotation is equal to force multiplied by leverage,* the whole amount of force upon the rim through that space must be exactly equal to the power applied through the fourth of an inch upon A. And so of each side of the two polygons respectively. But they are considered infinitely small and ultimately become parts of the two circles; the power therefore must be applied in a circle, and the particles of the rim must be propelled in circles with a force exactly equal to that power. Consequently, the moving power, applied to a fly-wheel or to any other revolving body, cannot be expended in pressing the particles of such bodies from the centres nor in the direction of tangents to the circles in which they revolve. And this is evident from the fact, that such moving bodies cannot give out nor impart, in any manner whatever, more force than is applied to revolve them. And *that force is not only equal* to the power applied, but it is always returned in the circle in which the body moves, *and in a direction contrary to that in which it was received.* "If a wheel spinning on its axis with a certain velocity be stopped by a hand *seizing one of the spokes,* the effort which accomplishes this is exactly the same, as, had the wheel been previously at rest, would have put it in motion in the opposite direction with the same velocity."* The force applied to the winch, in the case above, was wholly expended in giving velocity to the rim, with the slight exceptions mentioned. Consequently, whatever other forces may have operated on the rim whilst revolving must have originated in some other way. And yet those extraneous forces would amount to 1480 lb., as shown by the above formula, the rim weighing 150 lb. and being revolved at the rate of two entire revolutions in a second. No part of this force could be communicated to the arm of a man who would stop such a wheel by seizing one of the spokes, because *each particle* of the rim is acted upon by the central forces, which are always opposite and equal, in the direction of the radius of the circle *at that point;* and it has just been shown that the moment of rotation of each particle is equal to the moment of rotation of the power that impels it, but "as the direction of the central forces is in that of the radius, their moment of rotation is equal to nothing."† Consequently the centrifugal force cannot act upon the hand that stops the wheel. If, indeed, the centrifugal force were increased to sixteen times the above amount, the result would be the same. By giving the wheel eight revolutions in a second we would have the central force $= 1480 \times 16 = 23{,}680$ lb. and the force in the circle would be $= \dfrac{12{\cdot}57 \times 8 \times 150}{16} = 925$ lb. Here the centrifugal force is twenty times greater than the force in the circle, and yet as the central force would act in the direction of the radii, its moment of rotation would be $= 0$. Or, what is more strictly the fact, the central force acts by pressure, and a resultant from that pressure and the force in the circle is the consequence, but so long as resistance from cohesion continues, neither motion nor pressure can be imparted to another body by the central force. These are the obvious reasons why no greater force could be communicated by the rim than the 925 lb., which it only possesses as a mass of matter moving in a circle.

The following experiment may be considered as a practical illustration of the theoretical views given above. A whirling table may be made of any convenient size, we will say, for the present occasion, rather more than four feet in diameter, to revolve horizontally on friction rollers placed near the centre; the axle being a hollow cylinder, through which four cords pass to the floor to be connected with a tin tube for containing shot or some other weight. The cords are brought over the pulleys *p*, *p*, *p*, *p*, fig. 3, at the centre, and secured to the dishes *d*, *d*, *d*, *d*, weighing one pound each, and moving, with very

Fig. 3.



little friction, on little wheels adapted to the strips or rails *r*, *r*, *r*, *r*. By connecting this table with wheel-work, having bands or teeth acting on the hollow cylinder as a spindle, by means of a weight or power

* Kater and Lardner on Mechanics, p. 24.

† Renwick's Mathematics, Art. Composition of Forces.

suspended by a rope wound round an axle, and moving *very slowly*, a certain number of revolutions in a minute will be given to it by the power, in passing through a given space, and the four dishes will raise, by their centrifugal force, a weight in the tube below, proportionate to the velocity and their distance from the centre. If the *moving power be then doubled*, with a slight addition to overcome the additional friction and atmospheric resistance, it will be found, *that in moving through an equal space in the same time*, it will give twice the former velocity, and the dishes, at the same distance from the centre, will raise in the tube below, in an equal time, *quadruple the weight first raised*. Then by loading the dishes and increasing or diminishing the velocity, and varying the distances of the dishes from the centre, a variety of experiments may be made, and weights may be raised, with corresponding distances and velocities proportionate to those given above.

By observing the manner of performing the experiments with the magnetized bar, it will be seen that a centrifugal force is excited, INDEPENDENTLY OF THE PROJECTILE FORCE, equal to the supposed power of the magnet, and we have shown that the same effects would follow without the use of the magnet. And that the impelling or moving power performs no other part in producing the complex effects attendant upon rotation, than simply to move the particles of a mass of matter in circles about a fixed axis, may be clearly shown by the theory of curvilinear motion, which those experiments were designed to illustrate. But without attempting to prove this at present, by abstract mathematical reasoning, the nature of deflection and the extent of its operation in exciting the central forces, may be explained by a reference to the action of electro-magnetism as shown in Fig. 1.

The bar A, when attached by the magnet, being supposed to revolve in a circle of one foot in diameter, at the rate of eight revolutions in a second, or 25·14 feet, to determine the amount of deflection in any unit of time, say one fiftieth of a second, the whole space through which it moves in a second may be divided into fifty parts, which will give six inches for each unit of time. If this space be measured on the tangent from B to x, and on the circumference of the circle to v, the deflection for the one fiftieth of a second would be equal to the square of Bc, divided by BD, or the diameter. For by dynamics, "if a body revolve uniformly in a circle, the space through which it would move by the action of the centripetal force alone in any unit of time, such as a second, will be equal to the square of the arch described in the same unit divided by the diameter or twice the radius."* And the deflection of the bar in the $\frac{1}{50}$ of a second $= \frac{Bv^2}{2Bc} = \frac{6^2}{2r} = 3$ inches. That is, the deflection from the tangent Bg, during the time that the bar would have passed over six inches in that line, is three inches; and the deflection corresponding with the space Bg, which is equal to two feet, and through which the bar would have passed in the $\frac{4}{50}$ of a second, would be $= \frac{2^2}{2r} = 4$ feet, and so of any other space.

Now to show that the amount of this deflection or centrifugal force depends upon the curve in which the bar is moved in a given time, and not upon the moving power, or projectile force, we will cause the same bar, moving with an equal uniform velocity, to be attracted in a similar manner by the magnet m, attached to an arm revolving in a circle of eight feet in diameter, and let EF be an arch of that circle, touching the straight line Ag at B. As the velocity of the bar and the circumference of the circle are equal, the bar, after being attracted by the magnet at B, would move on with the same uniform velocity and perform one entire revolution in a second, friction and the resistance of the atmosphere being considered equal to nothing. And its deflection from the straight line, or its centripetal force for $\frac{1}{50}$ of a second, would be equal to the square of the arch Bz, which is six inches, divided by the diameter of the circle, that is $= \frac{6^2}{8} = \cdot 375 = \frac{3}{8}$ of an inch, or only one eighth of the deflection caused by the smaller wheel; and in the same ratio for any other spaces through which the bar would have passed whilst moving through equal spaces in the circle. And hence it is that the central forces are inversely as the diameters of the circles in which a body is made to move with a given velocity. The increment of deflection for an entire second being $= \frac{25\cdot 14^2}{1} = 632$ feet per second in the smaller wheel, and in the larger one $= \frac{25\cdot 14^2}{8} = 79$ feet per second only; and yet the bar has precisely the same velocity, and consequently the same force in the latter that it had in the former. Therefore, aside from friction, it would, if welded to m, require no more force to revolve it in the former than in the latter case.

For the same reasons, with a given velocity for the particles of the rims, the smaller a fly-wheel is, the greater will be the amount of centrifugal force, other things being equal. This will appear obvious upon inspecting the figure; for it will be seen that a particle of iron at v in the rim of a small wheel would be deflected from the straight line eight times as many inches in a given unit of time as a particle would be at the point z of the large wheel. The measure of the deflection from that line must therefore be the measure of the centrifugal force for any instant of time; and consequently the aggregate amount will be proportionate to the curve in which the body moves. This deflection takes place when a body is moved in a curved line, and the tendency to resist it and move in a straight line is excited in such a mass of matter in obedience to the important law of inertia, with as much certainty as electricity would result from the action of sulphuric acid upon two contiguous plates of zinc and copper. *Centrifugal force may therefore with propriety be considered a physical agent, which is called into action, by an inscrutable law of nature, whenever matter is made to move in a curve;*—which ought to be no more a subject of surprise, than that magnetic force should be excited in a bar of iron by certain chemical operations, the precise nature of which is as little understood as that of inertia.

The centrifugal principle has been employed as a projectile force from the earliest ages. It would be interesting to notice the extent to which it was used in ancient wars; and particularly to point out, as might be done even with the feeble lights afforded us, how much Archimedes was indebted to the central forces for the destructive effects of his engines, which I believe to have been no fabled nor imaginary productions of genius.

As I shall here come in conflict with some generally received opinions, I will give a short extract from Professor Renwick's Elements of Mechanics. Not that he differs from other writers on this subject, but I find that the extract will be useful in explaining what is to follow. "The simplest case of central force is where a body connected with a fixed point by an inflexible straight line is impelled by a projectile force at right angles to that line. The latter force would have impressed upon the body a motion with a uniform velocity. The body, then, in consequence of its connexion with a fixed point, describes a circle of which that point is the centre. If the connexion were to cease at any point in the curve, the deflecting force would cease to act, and the body would go in a straight line whose direction would be a tangent to the curve. The force acting at any point in the curve must therefore be decomposed into two, one of which is in the direction of the curve, the other in that of the radius."*

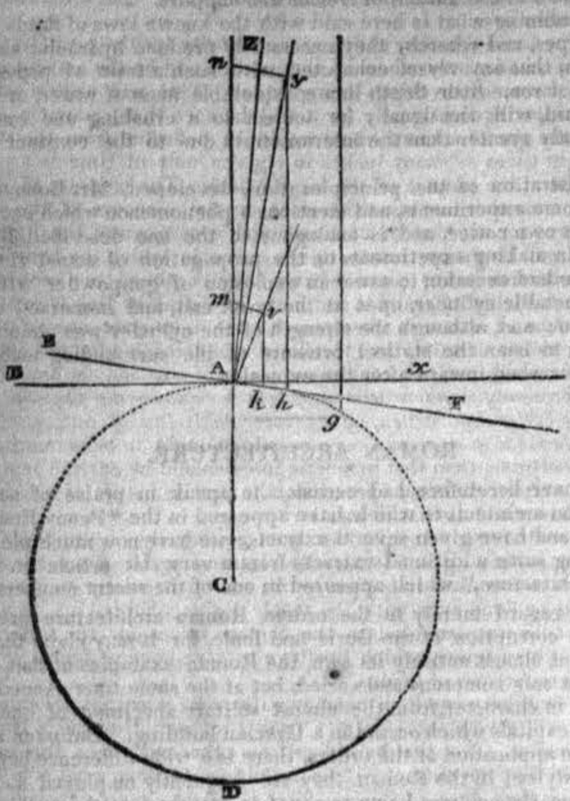
If a ball at A, Fig. 4, weighing one pound, and attached to an inflexible rod AC, two feet long, be impelled by a projectile force or moving power at the rate of two entire revolutions in a second, or 25$\frac{14}{100}$ feet per second, it will have a centrifugal velocity equal to 157·76 feet per second.‡ Those two velocities, then, equivalent to the forces 1·58 ℔. and 9·87 ℔. respectively, constitute the aggregate amount of force acting on the body at any point of the curve or circle; the former acting in the direction of the curve, and the latter in that of the radius—one caused by the motion of the particles of matter, the other excited by a cause producing pressure, resisted by cohesion. Now, according to the fundamental principles of mechanics, "the same cause acting upon a body will either produce motion or pressure, according as the body is free or restrained." And, "if two forces act upon the same point of a body in different directions, a single force may be assigned which, acting on that point, will produce the same results as the united effects of the other two." Here we have two forces acting on each particle of the revolving body, but they are resisted by cohesion, therefore when cohesion ceases to act, the effect of the two forces must be, according to the theorem of the composition of forces, to impel it in the direction of their resultant, and with an amount of force equal to their mechanical equivalent; and experiment shows the correctness of the theory. If an ounce ball of lead, with a small hole drilled through it, be firmly secured by a catgut string close to the perimeter of a fly-wheel, or any other wheel that can be rapidly revolved, it may be discharged from the vertical point of the circumference, whilst the wheel is revolving, by interposing a sharp knife well fixed in a slide. When the velocity necessary to project the ball horizontally at a given short distance has been ascertained, then by increasing the velocity and taking care to discharge the ball from the same point of the circle, and at an equal distance from the centre of the wheel, its elevation will be found to increase with the increased

* Brewster's New Edinburgh Encyclopedia, Art. Dynamics.

† Page 62.

‡ Cavallo, p. 66.

Fig. 4.



projectile force. And the experiment may be varied by having a number of balls prepared of the same weight, and varying the velocities and the distances from the centre. The effects of gravity, however, and the difficulty of representing by a straight line what may be considered the direction of the circle, have prevented me from determining *geometrically the direction* of the projectile, although in practice it may easily be ascertained.

If the ball be discharged from the point A with one revolution in a second, its velocity in the circle would be 12·57 feet per second, and its centrifugal velocity would be $= \frac{v^2}{2r} = \frac{12{\cdot}57^2}{4} = 39{\cdot}44$ feet per second, and the initial projectile velocity would be $= \sqrt{12{\cdot}57^2 + 39{\cdot}44^2}$ $= 41{\cdot}40$ feet per second, disregarding for the present atmospheric resistance. And if, in the way of illustration, AF be considered as the direction of the force in the circle AD, the sides A*k* and A*m*, of the parallelogram A*mvk*, being made proportionate to the two velocities 12·57 and 39·50 respectively, the diagonal A*v* of the parallelogram will represent in direction and proportional amount the velocity 41·45 or initial projectile velocity. If a billiard-ball, moving upon a table with a velocity equal to 12½ feet per second in the direction EF, were to receive at A an impulse in the direction of *cn*, which alone would cause it to move with a velocity equal to 39½ feet per second, no other direction and velocity could be assigned to it, than that designated by the diagonal A*v* of the parallelogram. The revolving ball is supposed to move in the direction A*k* with the velocity of 12·57 feet per second, represented by that side of the parallelogram, and at the same time to be acted upon by a force which would cause it to move with a velocity equal to 39½ feet per second, in the direction of the side A*m*, which indicates that velocity, consequently *no other direction nor amount can be assigned to it, when projected, than the diagonal* A*v of the parallelogram* A*mvk*. If the velocity of the ball be doubled, the centrifugal velocity increasing as the square of the increased velocity in the circle, it would be $= 39{\cdot}44 \times 4 = 157{\cdot}76$ feet per second, and the initial projectile velocity would be $= \sqrt{25{\cdot}14^2 + 158^2}$ $= 160$ feet per second; and the two first would be represented by the sides A*h* and A*n*, respectively, of the parallelogram A*nyh*, and the diagonal A*y* would indicate the direction and relative proportion of the initial projectile velocity. With four revolutions in a second, the initial projectile velocity would be 635 feet per second, in the direction of the line A*z*. At least such would be the directions for those three velocities *at the instant the ball leaves the point from which it may be discharged*. But with such low velocities a pound ball would not indicate those directions by its path, for the reasons given above. *With very high increasing velocities*, however, the experimenter will find that a small leaden ball will move in directions approaching that of the radius, as shown in the diagram. In repeated experiments made with a machine revolving vertically, and having a tube placed in the direction of a tangent to the circle in which leaden balls were revolved, it was found that with very high velocities they were forced through the tube with difficulty, and a portion of each was removed by the friction, and the upper part of the tube, on the inside, was worn smooth. But with much lower velocities the balls passed through the tube without any apparent friction.

In performing the first experiment, the bar, (A, Fig. 1,) moving with uniform velocity in every part of the circle BD, has the same centrifugal force at *v* that it would have after revolving for a minute or more; for the amount of that force depends upon the curvature and the circular velocity, and consequently was excited to the amount of thirty-nine pounds instantaneously, and if it had been discharged at three inches from B it would have been projected with that force. If this were not the case with bodies moving in space, supposed to be thus deflected, they would fall to the centre of attraction. Now as this is the fact, the *tangent* B*x* in the diagram only serves, as every mathematician knows, to show geometrically *the amount of deflection in a unit of time*, measured at right angles to that line, the space *xv* representing that through which the centripetal force alone, acting uniformly, would cause the body to fall in the fiftieth part of a second; the tangent, therefore, represents THE LINE FROM WHICH *the body would be deflected in an instant of time, and* NOT *that in the direction of which it would move with all its projectile force.*

Again, if the segment of a fly-wheel disintegrated by centrifugal force would be projected "in a straight line, whose direction is that of the tangent," the pressure which produces the fracture must act upon each particle of iron in the direction of a tangent to the circle in which the particle is revolved, for the direction of a moving body is always that in which a single force, or the resultant of two or more forces, acts to cause the motion. And it is self-evident that no amount of force, applied in that direction upon the particles in the revolving rim, could overcome the attraction of cohesion. And it is equally evident that such cannot be the direction in which the pressure acts, for whilst it is stated that the tangent is the direction in which the dissevered fragment is projected, we are informed that the force which causes the fracture acts at right angles to the tangent.

By the theory given above, however, which is founded upon observation and experiment, all the circumstances that attend this phenomenon are easily explained. And when we consider the immense increase of centrifugal force as the velocity of the rim is increased, *and the direction in which the resultant of the two forces acts*, we ought not to be surprised to find that such masses of iron can be broken and projected with so much destructive effect by this powerful agent. The operation of the sling may also, in this way, be explained in a few words. For a man, with a thong three and a half feet long, has only to give to a stone at the final effort a velocity, in a very small segment of a circle, equal to 132 feet per second, which would be at the rate of 360 revolutions in a minute, and he will project it with a force equal to that given to a ball of the same weight by an ordinary charge of gunpowder, after deducting one-third of its initial velocity for atmospheric resistance. But to "accumulate" an equal force in the circle by the strength of his arm, he would have to revolve the stone at the rate of 6850 revolutions in a minute, which is impossible.

Without intending to enter into any particulars as to the probable results of a practical application of this principle, I will close with a few remarks designed to show the amount of force excited by the rotation of heavy bodies about fixed axes, and the extent to which we may reasonably conclude it might be employed, if it could be controlled, by giving the relative proportions of the power necessary to revolve a body and the central force excited, considered abstractedly, apart from friction and atmospheric resistance. "The arc which the revolving body describes in a given time is a mean proportional between the radius of the circle and double the space which its centripetal force alone, acting uniformly, would cause it to fall through in the same time."* Consequently the diameter is to the circumference as the circumference is to the space which the centripetal force of the body would make it fall through in the time of one revolution. That space, therefore, is to the circumference as 3·141 is to unit, [3·141 being the circumference of a circle whose diameter is unit,] and the central velocity or force for an entire revolution in a second is equal

* Cavallo's Nat. Philos. p. 66.

to the circumference multiplied by 3·141. Hence *the ratio of the central force to the force in the direction of the circle, or the moving power, is as the product of the number of revolutions in a second by 3·141 is to unit.* That is, if there be two entire revolutions in a second, whatever be the weight of the body or its distance from the centre, the ratio of the centrifugal force to the moving power would be as 3·141×2 is to unit, or as six to one, nearly; and with eight revolutions in a second the ratio is as 3·141 × 8 to unit, or as twenty-five to one. And since "the velocity of rotation is almost unlimited,"* if a fly-wheel, similar to the one described above, were revolved at the rate of twelve hundred revolutions in a minute, the excited or centrifugal force in the rim would be equal to sixty-two and a half times the amount of power employed to give the requisite velocity, some deduction being made for friction and atmospheric resistance.

ON THE POWER OF FLUIDS IN MOTION.

In Silliman's American Journal for January last appears the following abstract of a paper read at the American Philosophical Society, "On a new Principle in regard to the power of Fluids in Motion to produce Rupture of the Vessels which contain them, and on the Distinction between Accumulative and Instantaneous Pressures; by Charles Bonnycastle, Professor of Mathematics in the University of Virginia."

Mr. Bonnycastle's investigation was suggested by a paper read by Dr. Hare, and printed in the Transactions of the Society, entitled "On the Collapse of a Reservoir, whilst apparently subject within to great Pressure from a Head of Water." Dr. Hare pointed out the circumstances attendant upon this curious occurrence, and showed how the vessel might have been momentarily relieved from the pressure of the water within, so as to make that of the surrounding air efficient in producing the collapse. The principal object of Mr. Bonnycastle's paper is to investigate the precise nature and degree of the forces brought into action in this and similar cases.

The results at which Mr. Bonnycastle arrived, are stated by him as follows:—

1. It is convenient to distinguish between accumulative and instantaneous loads, or between those which are gradually increased until the deflection due to the ultimate load is obtained, and those which commence in full efficacy from the initial position of the support.

2. Within the limits of perfect elasticity, instantaneous pressure produces twice the effect of that which is accumulative, whether the result be to produce deflection or fracture.

3. In regard to supports perfectly elastic in one direction, and perfectly flexible in the other, instantaneous action, at right angles to the axis of elasticity, produces a deflection which is to that of accumulative action as $\sqrt{4}$ to 1, whilst the tendencies to fracture are as 4 to 1. But should any case occur when the law of elasticity follows an extremely high power of the deflection, then the singular result will follow, that the deflections are the same, whether the force be exerted from the initial state or the state of load, but that the tendency to fracture will be immensely greater in the former case than in the latter.

4. In producing the fracture of natural substances, which all depart from the law of perfect elasticity as we approach the limit of fracture, the ratio of the effect of instantaneous and accumulative action will vary with the nature of the substance, never being less, for elastic bodies, than 2 to 1, nor for flexible than 4 to 1, and more usually approaching 3 or 4 to 1 for the former case, and 5 or 6 to 1 for the latter.

5. Let a vase or conduit be acted upon by a load which is alone sufficient to break it, and let this load be partly balanced by a small exterior force; should the great interior force suddenly cease, the small exterior action may crush the vase or conduit inward; its energy in such case being the sum of the interior and exterior forces.

6. Should the interior force be a vibration of the kind already explained, and should the exterior action be extremely feeble, and act on a very great mass, this extremely feeble action may crush the vase inward, with a power that shall exceed in any degree the enormous action of the interior or explosive vibration. The comparison of the interior and exterior actions is best effected in this case, by finding the modulus of elasticity of a material spring that shall coincide most nearly in effect with the interior tremor. For putting e and e' respectively for the modulus of the spring and of the support, and σ and σ' for the deflections resulting from the tremor acting alone, and the reaction as it does act, we have $\frac{\sigma'}{\sigma} = \sqrt{\frac{e}{e'}}$, or, in other words, the deflection produced by the reaction, is to the deflection that would be produced by the interior tremor alone, in the inverse proportion of the square roots of the moduli of tremor and support.

7. Combining what is here said with the known laws of fluids moving in pipes, and whereby they necessarily produce hydraulic shocks, it follows, that any vessel connected with such a train of pipes, and plunged at some little depth in a considerable mass of water, or other heavy fluid, will occasionally be subject to a crushing and exterior force vastly greater than the interior strain due to the constant head of fluid.

In illustration of the principles thus developed, Mr. Bonnycastle details some experiments, and mentions a phenomenon which occurred under his own notice, and is analogous to the one described by Dr. Hare. In making experiments on the propagation of sound through water, he had occasion to cause an explosion of gunpowder within a hollow metallic cylinder, open at the lower end, and immersed under the liquid; and, although the strength of the cylinder was abundantly sufficient to bear the statical pressure of the surrounding water, he found it crushed inward after the explosion.

* Fisher's Nat. Philos.

ROMAN ARCHITECTURE.

[We have heretofore had occasion to speak in praise of several articles on architecture which have appeared in the "Penny Encyclopædia," and have given several extracts; we have now much pleasure in making some additional extracts from a very able article on "Roman Architecture," which appeared in one of the recent numbers.]

With regard merely to the orders, Roman architecture presents chiefly a corruption of the Doric and Ionic, for it may claim the Corinthian as almost entirely its own, the Roman examples of that order being not only numerous and varied, but at the same time exceedingly different in character from the almost solitary specimen of one with foliaged capitals which occurs in a Grecian building. But even as regards the application of the orders, there is a wide difference between the two styles; in the Roman they are frequently employed as mere decoration, the columns being *engaged* or attached to the walls, or in some cases (as that of triumphal arches) though the columns are insulated and advanced from the structure, they are in a manner detached from it, inasmuch as they do not support its general entablature, but merely projecting portions of it. Nor are these the only differences, for besides the frequent employment of pilasters as substitutes for columns—that is, as constituting the order without columns—the practice of *supercolumniation*, or raising one order upon another, was by no means uncommon; a practice that was indeed a matter of necessity in such enormous edifices as the Colosseum, if columns were to be employed at all. From all this it will be evident that, as regards the orders alone, there is a very marked difference between Roman and Grecian architecture; yet such difference is by no means the whole, the two styles being almost opposites in nearly every respect. If there were no other distinction between them, that arising from the arch, and diverse applications of its principles to vaults and domes, would be a very material one; but we also meet with a variety and complexity in Roman buildings which does not occur in those of Greece. The only instance that we are acquainted with in Grecian architecture, of anything like grouping or combination of building, is that of the Erechtheion, or triple temple on the Acropolis of Athens. With this exception, Greek temples were merely simple parallelograms, differing from each other as to plan only in the number and disposition of the columns around the cella; consequently, however beautiful when considered separately, a very great monotony prevailed in that class of buildings, at least, in which the forms were so limited and fixed as to preclude any fresh combinations, or anything approaching to what is understood by composition.

By the adoption of the circular form in their plans, whether for the whole or parts of a building, the Romans introduced an important element of variety into architectural design; especially when we consider that to such shape in the ground plan is to be ascribed the origin of the *tholus*, or concave dome, which harmonizes so beautifully with all the rest, and renders the rotunda-shape at once the most picturesque and the most complete for internal effect,—that in which both unity and variety are thoroughly combined. The Pantheon alone would suffice to convince us that the Romans were not mere copyists, and that if as such they deteriorated the Greek orders, they also added much to the art, and greatly extended its powers by new appliances. As regards its exterior, the Pantheon presents what is certainly a strikingly picturesque (and what we consider to be also a consistent and appropriate, because a well-motived) combination, namely, of a rectangular mass projecting from a larger circular one. In that example the body of the edifice, or rotunda itself, has no columns exter-

nally; but circular peristylar temples, or rotundas, whose cella was enclosed by an external colonnade, were not uncommon. Of this kind is the temple of the Sibyl, or, as it is otherwise called, that of Vesta, at Tivoli, an edifice of singular beauty, and highly interesting as a very peculiar and unique example of the Corinthian order, the first application of which in any modern building was made by Soane, at the Bank of England. Edifices of this kind were covered with hemispherical domes, or with smaller sections of a sphere, which consequently did not show themselves much externally, as they were raised only over the *cella*, and therefore the lower part was concealed by the colonnade projecting around it. The dome of the Pantheon is hemispherical within, but is of very low proportions and flattened form without, for its spring commences at about the level of the first or lower cornice of the exterior cylinder, and is further reduced by the base of the outer portion of the dome being expanded and formed into sepaarate cylindrical courses or gradini. If the dome had sprung immediately from the upper cornice, so as to present a perfect hemisphere on the outside, the rotunda itself would have looked merely as a *tambour* to it, and the effect would have been as preposterous as if the cupola of St. Paul's and the colonnaded rotunda on which it is raised were placed immediately on the ground, instead of being elevated upon a larger pile of building.

Polygonal forms of plan were sometimes employed, of which there is an instance in what is called the temple of Minerva Medica at Rome, which is circular on the exterior, but internally decagonal, with nine of its sides occupied by as many recesses, and the other by the doorway—a remarkable peculiarity, it being very unusual to enclose a polygon within a cylindrical structure, although not the contrary, nor to erect a cylinder upon a square or polygonal basement. Octagon plans were by no means uncommon: such form was frequently made use of for the saloons of public baths; and there is an instance of an octagonal temple, supposed to have been dedicated to Jupiter, in one of the courts of Diocletian's palace at Spalatro. Of hexagonal structures we are acquainted with no example, but a court with six sides occurs in the remains of the temple of Baalbec, not however a regular hexagon, but of elongated figure, two of the sides being 110, and the remaining four 88 feet each. In the later periods of Roman architecture, circular and polygonal structures became more frequent, and those of the first-mentioned kind deviated considerably from the original simple rotundas and circular temples. An inner peristyle of columns was introduced so as to make a spacious circular or ring-shaped ambulatory around the centre, which was much loftier than the colonnade being covered by a dome raised upon a cylindrical wall over the columns. What is now called San Stefano Rotunda, at Rome, supposed by some to have been originally a temple dedicated first to Faunus, and afterwards to the emperor Claudius, and by others to have been a public market, is a structure planned according to the arrangement just mentioned, with a circular Ionic colonnade of twenty columns and two piers. The Church of Santa Costanza, traditionally reported to have been a temple of Bacchus, but now generally supposed to have been erected by Constantine as a baptistery, and afterwards converted by him into a funeral chapel to his daughter Constantia, is a remarkable example, owing to the columns being not only coupled, but unusually disposed, and to there being arches springing from their entablature, that is, there are twenty-four columns (with composite capitals) placed in pairs, on the radii of the plan, or one behind the other, forming twelve inter-columns and as many arches; and as far as the mere arrangement goes, this interior is strikingly picturesque; but it would be an improvement, if the dome were in such case to spring immediately from the imposts of the arches, and the latter to groin into it; or at least were it to spring from the vertex of the arches.

The circular form was a favourite one with the Romans for their sepulchral structures of a more pretending class than ordinary. It will be sufficient here merely to mention those in honour of Augustus and Hadrian. The tomb of Cæcilia Metella is a low cylinder, the height being only 62 feet, while the diameter is 90; and it may be considered as nearly solid, the chamber or cella being no more than 19 feet in diameter. This cylindrical mass is raised upon a square substructure; which combination of the two forms is productive of agreeable contrast; and it was accordingly frequently resorted to. The tomb of Plautius Sylvanus near Tivoli consists also of a short cylindrical superstructure on a square basement, but is otherwise of peculiar design, one side of that stereobate being carried up so as to form a sort of low screen or frontispiece, decorated with six half-columns, and five upright tablets with inscriptions, between them. The tomb of Munatius Plancus, at Gaeta, is a simple circular structure, of low proportions, the height not exceeding the diameter, and therefore hardly to be called a tower, notwithstanding that it is now popularly called Roland's or Orlando's Tower. Of quite different character and design from any of the preceding ones, is the ancient Roman sepulchral monument at St. Remi, which consists of three stages; the first a square stereobate raised on gradini, and entirely covered on each side with sculptures in relief; the next is also square, with an attached fluted Corinthian angle, and an open arch on each side; and the uppermost is a Corinthian rotunda, forming an open or monopteral temple (i. e., without any cella), the centre of which is occupied by two statutes.

These notices may serve to convey some idea of the variety aimed at by the Romans in the distribution of the plans and general masses of their edifices, independently of decoration. Their thermæ, or public baths, a class of structures remarkable for their vast extent and magnificence, are most interesting studies of combinations of plan, as they were not merely baths, but places of public resort and amusement, and consisted of an assemblage of courts, porticos, libraries, and spacious saloons and galleries, most of which presented some peculiarity of form and distribution.

The Romans seem to have affected the practice of grouping buildings together as features in one general symmetrical plan. Their temples and basilicas were frequently placed, as the principal architectural objects, at the extremity of a forum, or other regular area enclosed with colonnades. The temple of Nerva stood at one end of, and partly projected into an enclosure (measuring about 360 by 160 feet), the entrance end of which had five open arches, and the sides were formed by screen walls, decorated with Corinthian pilasters, and columns immediately before them, over which the entablature formed breaks. Of Trajan's forum, which was surrounded not only by colonnades, but various stately edifices, nothing now remains except the celebrated triumphal column that occupied its centre, and which, so placed as a principal object, must have heightened the splendour of the whole. Like that of Nerva, the temple of Antoninus and Faustina was placed at one end of a court of moderate dimensions, whose sides were adorned with coupled columns placed immediately against the walls; and only the portico part of the temple (a Corinthian hexastyle, triprostyle) advanced into the enclosed area in front. The forum of Caracalla was nearly a square, entirely surrounded by arcades, presenting thirteen arches on each of the longer and eleven on each of the shorter sides. In the centre was a Corinthian temple very similar in plan to the Pantheon, with an hexastyle, triprostyle portico in front, and remarkable for having inner columns behind the second from each angle, so that there was a double range of them at each end, and the central space within the portico was a perfect square equal to three intercolumns.

As our object is rather to direct attention to the modes of composition affected by the Romans and the elements of their style, than to describe their chief architectural monuments, either historically or according to their respective classes and destination, we proceed now to consider some of the individual peculiarities and features belonging to their buildings.

In the application of sculpture, particularly of statues, they were prodigal; but they employed the latter chiefly as architectural accessories, frequently placing them over columns, or on the summits of their edifices as acroteria to pediments, by way of giving variety to the outline of their buildings, and also of indicating at first sight their particular appropriation—a practice almost unknown to the Greeks, there being only one instance of it. In Italian buildings, on the contrary, the practice has been frequently carried to a preposterous extent, rows of statues being placed on the pedestals of balustrades, so as almost to look like pinnacles, and to produce rather a stiff and formal effect than one of richness; whereas when they are introduced on the angles and apex of a pediment, or when there is merely one in the latter situation, such monotony does not take place, and additional importance and loftiness may be given to that portion of the edifice by such decoration. The abundant use of statues led to the adoption of the niche—a feature unknown in Greek architecture—as a convenient mode of inserting them within the surface of walls, and thereby decorating them; at the same time space was gained in interiors, where, if otherwise placed, they would have taken up room. Niches frequently occur in Roman temples and baths; and, as we have seen, from the account given of the temple of Venus and Roma, were occasionally decorated with a frontispiece of small columns, with their entablatures and pediments, but were generally left plain, and were for the most part semicircular in plan, in which case they usually terminated in an arch and semidome, after the manner of a tribune or large recess, of which the niche was in fact a miniature copy. Niches, however, were very frequently rectangular in plan, as were also exhedræ, or recesses, in which case the latter formed arches vaulted hemicylindrically.

These various applications of curvilinear forms, both in plan and elevation, undoubtedly furnished Roman architecture with resources unknown to that of Greece. Nor can it be denied that the arch itself is a very beautiful feature, although it was employed by the Romans

to such excess as rather to occasion monotony than to contribute to variety of design; for if the general character of Greek temples was invariably uniform, presenting in the exterior merely lines of columns, the amphitheatres and similar works of the Romans consisted only of continuous tiers of arches, which constituted their more strongly marked features, the columns placed against their tiers being merely ornamental accessories, and comparatively of little effect, and even that not of the very best kind. In either case—the Roman or the Greek—a single compartment of an edifice, whether arcaded or colonnaded, serves as a pattern for the whole; and although uniformity and continuity conduce to grandeur, yet if precisely the same kind of uniformity recurs in every building of the same class, it becomes wearisome.

We now come to consider a practice eventually adopted, by means of which the arch and column became amalgamated as integral parts of the same ordinance, viz. that of supporting arches upon columns, making them spring either directly from their capitals or from an entablature-shaped block over them. We are aware that this practice is almost uniformly condemned as barbarous and absurd; yet in our opinion somewhat too hastily, and with more of prejudice than of fair examination. That it was introduced during the decline of the art, and that it was an innovation subversive of former principles, is not to be denied. Yet if it must be reprobated, it ought to be so for its own demerits, not as an innovation; for all invention is such. It appears a very poor argument against it, to say that columns were originally designed to support horizontal architraves; we do not see how that circumstance, of necessity, renders every other application inadmissible. At that rate we must censure as vicious a great deal of both Roman and modern architecture, where attached columns are employed merely as ornaments, yet, as frequently as not, in such manner as to produce a character of littleness and poverty, they being so small in proportion to the rest as to appear insignificant, and at such intervals from each other that all the beauty and harmony of a columnar ordinance is lost. Where columns are employed to support, it certainly cannot be alleged that they are idle unmeaning expletives; nor that they are mutilated by being apparently partly embedded in the wall behind them. "A pier," it has been remarked by an intelligent writer, "is but a differently shaped and more massive column;" which being granted, what impropriety can there be in employing the latter as a substitute for the other, provided it be done with judgment and discretion, and where, upon the whole, it will prove an advantageous mode of treatment? It certainly is a barbarous mode to turn small arches upon columns, which are not more than between two and three diameters apart, of which we have examples in the basilica of S. Paolo, and Santa Agnese fuor delle Mura, at Rome. The intercolumns are such that they might easily have been closed horizontally; indeed the openings between the columns have scarcely the appearance of being arches; but the whole looks as if the wall resting upon the columns was scooped out into diminutive arches over the intercolumns. In those instances, too, the arches themselves are quite plain, without archivolt or mouldings of any kind, and consequently all keeping is destroyed; the architectural embellishment terminates with the capitals of the columns, and so far the effect is similar to what would be produced by placing a plain horizontal mass upon a range of columns, instead of a moulded entablature. Although one of an opposite kind, it is equally a fault to make the arches spring not immediately from the capitals of the columns, but from square fragments of entablature over them (as, for example, in the interior of St. Martin's, London) not only because such fragments are unmeaning in themselves, and suggest the idea of the columns having been found too short for their intended purpose, but because they remind us quite unnecessarily of the original application of the column to the horizontal entablature. If entablature be admissible at all, it is when the columns are coupled, as in the church of Costanza already noticed; for then some kind of architrave at least becomes requisite, in order to connect the two capitals, as it were, together. One very great advantage attending the combination of the arch with the column as its support, is, that it allows the openings to be considerably wider than they otherwise could be, because such intervals as would produce a poor and straggling effect in a colonnade, become well proportioned and agreeable when spanned by arches. Such columnar arcades have frequently been employed by the Italians with happy effect in *cortili* and places of that kind, where piers of the usual kind would obstruct the view too much, and where intercolumns of the same proportions, between pillars supporting a horizontal entablature, would have a poor and disagreeable effect, particularly if, as is generally the case, other stories of the building rested upon the porticoes below. In fact, ordinances composed of arches and pillars constitute the best specimens of Italian columniated architecture. That in the cortile of the Palazzo Piccolomini at Siena, the work of Francesco di Giorgio, is singularly beautiful in its distribution, remarkable for the richness of its details, and also for the variety which it presents in perspective, as may be judged from the view of it given in Grandjean and Famin's "Architecture Toscane." We have already mentioned the interior of St. Martin's as containing an example of arches upon columns, and that of St. Bride's, London, furnishes another, but neither is a favourable one. A more satisfactory example may be found within the loggia of the Strand portion of Somerset House, where, though the arches spring from entablatures over the columns, yet as the latter are placed in pairs, those horizontal parts are more than mere upright blocks over the capitals. The quadrangle of the late Royal Exchange, London, had arches springing immediately from the capitals of the columns, but their breadth was excessive in proportion to the height of the latter, and their elliptical form was a great defect, and certainly did not at all contribute to beauty. All that we contend for is the principle on which the practice is founded; for as to the merits of the buildings in which it is adopted, that must, like every thing else in architecture, depend upon the taste shown in the particular application of it, which may be exceedingly good or altogether the reverse. Hungerford Market affords a good example of an ordinance composed of columns and arches, and also an idea of the general character of a basilica, though of course somewhat modified, and without any sort of architectural luxury.

ARCHITECTURE OF LIVERPOOL.

NORTH AND SOUTH WALES BANK.

In an article in thy Journal headed the Architecture of Liverpool, signed H., occurs the following sentence. "This is an example of the effects of modern competition, where the successful architect, having had his design adopted in consequence, it is said, of his private interest in the committee of management, has not only the advantage, as was understood at the time of examining those of his competitors, during the six weeks which elapsed between the decision of the committee and the return of the designs to their respective authors, but is permitted to expend about twice the amount to which they were in the first instance limited;" which under the mean mark of, "it is said," hides four distinct assertions meant to reflect discredit on the committee of management and on myself,—all four are thoroughly untrue. In the first place I, the architect, had my design chosen unanimously by the committee, without the interference of any private interest. Secondly, I did not either at the time of the designs being before the committee, or any other time see, or have opportunity to see any one of them, (excepting only the one considered second best, sent by Mr. Leigh Hall, of Manchester, and to see which, I went to his office by his own invitation some months afterwards.) On the contrary, the manager of the bank carefully kept them unseen after the decision, until at various times they were sent for by their owners—considering it his duty to the unsuccessful architects; and certainly I should not have been mean enough so to examine them, or under the shuffling cloak of the words "understood at the time," to assert and publish anonymously that any other person did so, unless I had known it of my own knowledge. Thirdly, The time the plans were in the directors hands was four, and not six weeks, and during all that time I was engaged in a tour in the west of Scotland and the north of England. And fourthly, no amount whatever was named to limit the architect, and the sum expended is not greater than was anticipated, and shown by the architect, except such part of it as is due to the fact of the foundations having to be taken down 27 feet below the surface, in consequence of the discovery of the site being partly that of the old castle ditch of Liverpool, and which part of the cost is well invested by the building in that depth, strong and valuable bonding vaults. I send a ground plan by which you will see that H. contradicts himself, by stating that the obtuseness of the angle is rendered "most painfully obvious," by my having placed the line of wall "at right angles to the long side, and therefore not parallel to its own line of front;" *it is* parallel to its own line of front, and therefore is 6½ feet in 35 more obtuse than a right angle; surely the writer must have distorted vision who could not see the difference between an angle of 101 degrees and a right angle, even when it was rendered "most painfully obvious," the fact shows that the obtuseness of this angle was a "difficulty" so "overcome," as to baffle his discernment. That I have taken away by my pilasters two feet in width, and by the entrance five feet in length, is untrue; the bases are allowed by the town's authorities to project beyond the building line, and the space from the front of the pilaster to the inside of the stone work of wall is just two feet, so my judicious and veracious friend H. would leave nothing for the thickness of the wall; this blunder arises no doubt from the common practice of making pilasters merely accessory; in my building

they *are the wall*, and are throughout the structure *the support*. The building has been admired not only by your judicious writer "Eder," but by many whose opinions are at least as well worth having as that of the sharp-sighted H.

I am, respectfully,

King Street, Manchester, EDWARD CORBETT, *Architect.*
3rd Month 2, 1841.

RAILWAY ACCIDENTS.

SIR—As the greater number of fatal accidents which have recently occurred on railways may be fairly (at least in my opinion) traced to a want of sufficient look-out ahead, it has occurred to me, that great advantage would result from having a third person as a conductor on the engine, whose duty it should be exclusively to attend to the signals, keep a look-out ahead when the train is in motion, and apprise the engineer of any other train, workmen, materials, &c., being on the line from which danger may be apprehended, as also to apprise such train, workmen, &c. of the approach of that to which he is attached.

This person should not be associated with the engineer and stoker on the stage behind the fire-box, but should be elevated on a seat before the chimney, where he would at all times have a much better opportunity of keeping a look-out than the engineer has, whose view is often partially or entirely obstructed (as I have frequently observed) by the steam escaping from the valves, or by the smoke and steam from the chimney, besides the disadvantage the engineer always labours under in looking along the side of the boiler. The situation of the conductor would be particularly advantageous in the night for observing the signal lamp of a train in advance, which from its position may be easily overlooked by the engineer, who has the light of his own fire to distract his attention.

The situation of the conductor which, is herein advocated, I am aware would be attended with little advantage without an adjunct. I therefore propose that there should be two whistles on the boiler, over the fire-box, with levers and rods attached to them, leading to the seat of the conductor, so that by means of them he may easily communicate with the engineer, or give warning to the train or workmen, &c., on the line before him. One of these whistles should be used as a warning only, and the other to convey to the engineer a peremptory order to stop the engine in case of a sudden emergency. The engineer should still have, as at present, the means of working the cautionary whistle, independent of the conductor; and he might be furnished with an apparatus to arouse the attention of the latter in case of his being in doubt.

The responsibility and attention of the engineer would not necessarily be diminished by the adoption of this plan, on the contrary, while he should be required to keep as vigilant a look-out as at present, the superior situation of the conductor would be a great additional security to the lives and property of the public. The directors of railways incur, as was very properly expressed by them at their late meeting at Birmingham, a fearful responsibility, and it behoves them to take every precaution in their power for the protection of the lives and property intrusted to their care.

Should this suggestion prove to be the means of lessening the danger of the public, and the responsibility of those whose duty it is to protect them, the object I had in view by troubling you with this, will be fully answered. Begging the favour of your giving this a corner in your valuable Journal,

I remain, Sir, your most obedient servant,
A CIVIL ENGINEER.

Thornhill, near Wakefield,
March 11, 1841.

PUBLIC SAFETY AND CONVENIENCE.

SIR—It is to be hoped that the recent accident of two houses falling down in so public a thoroughfare as Fleet Street, which is constantly thronged during the day time, will at least have the good effect of exciting greater vigilance for the future. But, at present, it seems there is no adequate authority which can interfere imperatively and instantly in such cases; or, if there be any authority and responsibility, there must be most scandalous and criminal negligence somewhere or other.

Passing the other day through that not very refined but now classical locality of Pickwick celebrity, yeleped Goswell Street, I was struck by the frightful manner in which, owing to the accumulation of earth behind it, the churchyard wall bulges out above in such manner, that it looks as if about to give way. Would it not, therefore, be advisable to ascertain whether there is any real danger of its doing so, and whether it would not be prudent to strengthen it by buttresses at intervals?

That far greater attention is paid to the comfort and security of pedestrians in London than in any other capital or city, may be readily admitted; nevertheless there are improvements which might be adopted, were all that relates to the care of the public streets placed under the control of a general Board for the whole metropolis. Though it may be thought a very trifling matter in itself, it would be well were there some kind of authority to regulate the names of streets, and thereby prevent the inconvenience sometimes occasioned by the same name being borne by half a dozen or half a score different streets in various parts of the town. Surely it would not be a matter of great difficulty to find a distinct name for every street, even were the metropolis to grow to twice its present size. Therefore, although to attempt now to correct the present nomenclature, by naming afresh some of our numerous George Streets, King Streets, Castle Streets, might occasion as much confusion as it would obviate, there might be a regulation, ordering that in future, no new street should have a name already appropriated by some other.

Far more essential is it to the public that they should be enabled to cross such exceedingly wide carriage ways as those in Oxford Street, Regent Street, Charing Cross, Whitehall, Holborn opposite Furnival's Inn, &c., with less inconvenience and danger than they now incur. What objection there can possibly be to erecting a lamp-post here and there, with short posts around it, so as to form a secure spot midway of the crossing where foot-passengers might stand in security, it is difficult to conceive. It is true something of the sort has been done already, but not effectually; for the crossings are still left dangerously wide, as for instance, that opposite Northumberland House, where there ought to have been two lamp-posts and resting-places instead of a single one. Besides, why should there be none at all in Regent Street, &c., where they are quite as much wanted? or does it not matter whether people be run over by carriages in those particular places? Another thing that might be attended to, were it made any body's duty to do so, is the sweeping the crossings in dirty weather, for the swept pathway is generally so narrow, that if two persons meet, they must either jostle against each other, or one of them step into the mud. At the time of the thaw, some weeks ago, the streets were almost impassable for foot-passengers; which would not have been the case had the snow been entirely cleared away from the crossings, leaving there a passage of about 12 feet broad.

There ought to be some regulation for providing *urinals* at suitable distances, whereas, at present, there seems to be no regulation at all in regard to them, that being a public accommodation left entirely to chance; so that in many parts of the town it is difficult to meet with any place of the kind. Yet, if no where else, one might be fixed at the entrance to every carriage mews; and not only might they be better contrived than they usually now are, but it should be made the duty of the police to see that they are not scrawled over in the disgusting manner they frequently are.

Unfortunately it is worth nobody's while to make a stir about such matters, because they are not of the kind which the newspapers gabble about. No! any one might gain greater celebrity any day by merely standing on his head at Charing Cross.

I remain &c. &c.,
A PEDESTRIAN

Metallic Relief Engraving.—As you are ever anxious to give the first tidings of new inventions, I doubt not the two following embryo methods of engraving will be as interesting to yourself as to your readers:—Take a tablet of plaster of Paris, and, having heated it, apply wax for absorption to all the faces save that on which you intend your drawing to be, and to that one apply your drawing, executed with lithographic ink, on lithographic transfer paper. Let the side of the tablet on which is the transferred drawing, be now dipped in weak acid and water, and then permitted to absorb a solution of sulphate of copper. By electro-metallurgy a deposition of copper can be made on all parts stained with the sulphate. Ere this coating be too thick, let the tablet be removed from the vessel in which this last operation has been carried on, washed *carefully*, dried, and a mixture of isinglass and gin be poured on it; its redundancy be gently blotted off with blotting-paper till the surface be level (*i. e.* the copper lines and isinglass cement be of the same height): again, let the deposition take place, and again its succeeding operation; after which let common black lead be rubbed over the whole surface; and the deposition being renewed, a copper mould, from which a type metal block may be subsequently cast, is now formed.—*Another method.*—Draw with a pen dipped in warm isinglass coloured cement, and when your drawing be dry, for an instant expose it to steam, and then coat it with leaf gold. Proceed by electro-metallurgy, as in last method, and no cast is necessary.—*Athenæum.*

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXV.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. It were to be wished that some of those who profess to admire Palladio, would be at the trouble of specifying his particular merits and beauties by pointing out striking instances of them in his works. Instead of which they deal only in vague eulogium, which teaches nothing. Surely they do not mean to say that it would not be worth while to perform so good an office for their favourite, nor can we imagine that it would be either a difficult or a disagreeable one to themselves. On the contrary it would afford them the opportunity of dwelling upon his excellences one by one, while such analysis of them might perhaps enable them to detect, to a certain extent at least, the secret of his peculiar art in composition. Neither would the task be at all superfluous, because I have met with others besides myself, who have confessed that they have not only been struck by egregious faults and solecisms in Palladio, but have been utterly unable to perceive any counterbalancing merits in him,—at the best no very striking beauties. For my own part I should say there is scarcely any work of Palladio's which does not afford an instance of something or other tasteless or faulty. By no means do I intend to deny that there are many useful elements to be derived from them, but as exhibited in his own compositions, they are either valueless, or else overpowered and neutralized by the rest.

II. It is likewise not a little remarkable that after Professor Hosking's bold attempt "to disabuse the public mind as to the merit of the work of Vitruvius," not only the public but professional men should continue to speak of it with implicit deference as before, and without attempting in turn to vindicate it from the aspersions so cast upon it, just as if the opinion put forth in such diametrical opposition to their own, had been given to the world anonymously in some obscure newspaper paragraph, instead of proceeding from an authoritative quarter, appearing in a treatise in the Encyclopædia Britannica, afterwards published separately, as a manual for students, consequently likely to prove extensively mischievous—at least in the opinion of those who still continue to "swear by Vitruvius," looking upon him as an infallible oracle. If such persons are perfectly sincere—which is somewhat problematical—their silence argues a great want of moral courage, since they patiently allow their oracle to be treated with contumely and indignity, without reproving the offenders;—unless indeed it be by merely affecting to sneer "at the small fry of critics who carp at Vitruvius." Such cool contempt may look very magnanimous, but it is in reality little better than cowardice, and a virtual acknowledgment that the less the merits of Vitruvius are inquired into, the better for him and his admirers. It is not denied that his writings have some interest, but then it is almost entirely in a philological point of view. They may occasionally help to elucidate archæological facts; but as far as the study of the art is concerned, they require to be elucidated by means of the other more satisfactory and more copious sources of information now opened to us. Perhaps it would have been a blessing to architecture had they never been discovered, for they have undoubtedly exercised a baleful influence on the Italian school, since had it not been for the blind deference paid to them, it is probable that on the revival of Roman architecture, the great masters would have freely imitated the orders of antiquity, instead of cramping the art, by establishing positive rules for each, and by endeavouring to make them conform as nearly as possible to the *recipes* given by Vitruvius;—in contradiction to that license—if it must so be termed, which manifests itself in actual examples—not those afforded by buildings alone, but by detached specimens and fragments, some of which are infinitely more valuable as artistical studies. Would Vitruvius help us to the Tivoli Corinthian, or to any of those varieties of the Ionic capitals, &c., which we meet with in Piranesi's "Magnificenzes"? Vitruvius and the Italians who have given us their codes of the orders, would reduce each to a single *pattern*: Doric, Ionic, and Corinthian, must each be put into its respective uniform, the precise cut of which is established by their martinet regulations, which, like the laws of the "*Maids* and *Parsons*" as Hook calls them—are to remain unaltered.

III. In this country architecture—or at least the study of it, seems to be just now marching at quick pace—backwards. While the Institute is forming a collection of the various editions of Vitruvius, the Royal Academy Professor is instilling some very odd notions into his audiences;—of course quite orthodox, since he himself must be looked upon as the very centre and fountain of orthodoxy; nevertheless far from being of the most enlightened kind, or manifesting a genuine *Catholic* love of the art. Wren seems to be the god of his idolatry—the master to whom he would refer us at the present day as the standard and compendium of architectural excellence. He claims our admiration not only for St. Paul's,—which we most readily concede, but for every other production of Wren's, although the majority of them possess no beauty whatever, but on the contrary display utter want of taste, and scarcely any invention.

IV. I am sometimes inclined to wonder, not that architecture should not be cultivated as a mere study, but that it should have any volunteer followers at all, for the silly trifling, the dulness, the pedantry, the bigotry, the extravagant galimathias, the downright nonsense, one has either to *wade* through, or else *evade* by skipping over,—are enough to disgust people with most treatises on architecture. As a mere vague, indistinct poetical analogy, something of the kind may be fancied to exist between architecture and music; but to adopt such speculations seriously as Vitruvius suggests—although he has not explained *how* we are to set about doing so, is sheer extravagance—a will-o'-the-whisp chimera, a delirium of the intellect. A thousand other analogies just as much to the purpose, just as substantial, and not a whit more whimsical might be traced by any one who chooses to be at the trouble of doing so. For instance, I myself would engage to show the analogy between Architecture and Cookery much more clearly and explicitly than has hitherto been done in regard to that fancied to exist, between Architecture and Music. The fantastic opinions promulgated by some in regard to architecture, convince us that Swift's Laputa is no caricature—quite the contrary, for the idea of extracting sunbeams from cucumbers, or of applying trigonometry to tailoring, seems perfectly rational compared with Michael Angelo's queer crotchet—viz., that a knowledge of anatomy is indispensable to the architect; or with the crazy metaphysical rhapsodies of Padre Georgi and his "Platonic principles" in architecture! what lunatic reveries!

V. Among the very queer things which have fallen from the Professor's lips during his course of lectures, may be reckoned, his admonition to students to avoid aiming at the Picturesque in architecture. Without going any further, it would be sufficient to remark that the advice, however salutary, is perfectly superfluous, for whatever else may be alleged against modern architecture and architects, it is quite impossible to lay picturesqueness, or the aim at it, to their charge. On the contrary we see building after building erected, which are remarkable for nothing so much as the entire absence of all picturesque quality, so that if not amenable to criticism when examined by standard rules, they are quite spiritless and insipid. Even allowing that the advice was intended chiefly as a caution to the junior students, to guard them from the error of attending chiefly to such effect, and overlooking more important considerations,—it does not seem to be of the soundest and most wholesome kind. If the architect intends to become more than a builder, we should say, it is highly important that he should begin to cultivate his taste, to exercise his fancy as soon as possible. For if the imagination is to be restrained until the judgment shall have been matured, and until proficiency in practical knowledge shall have been attained, the probability is that there will then exist no imagination to be brought into play. To expect that they who begin as plodders will end as artists, is to expect the order of nature will be reversed—that after-life will prove the season of genial inspirations and high imaginings which never came across the mind in youth—and that after years of torpidity and dulness, the powers of fancy will burst forth with peculiar vigour. Methinks it would have been greatly more to the purpose had the Professor exhorted his pupils to endeavour to secure picturesque quality in the first sketches of their ideas upon paper, and then rigorously to revise them, correcting, sobering down, maturing, until the whole should satisfy the judgment as well as the fancy. If, indeed, the principal or sole merit of a design consists in its being picturesque, it will be more or less defective in more essential points; yet that quality in itself is not a defect, unless it can be shown that every thing else has been sacrificed in order to obtain it. I almost wonder the Professor did not follow up his admonition by a fling at that specimen of the picturesque in architecture which his predecessor both at the Academy and the Bank of England,—has given us in the North-west angle of the last-mentioned building. And except that, there is hardly another instance about town, where picturesque expression has been studiously brought in, unless it be in that very strange piece of architecture in the Assurance Office in the Strand, which the Professor should have held out *in terrorem* to his pupils, and held up in derision to his audience generally.

VI. Some one, I find, has been liberal enough to say of me in a newspaper critique on one of the late numbers of the "Civil Engineer," that if I wanted a motto, I might take "Castigat Ridendo" for the

purpose, and that my remarks, though "exceedingly pleasant, are also confoundedly caustic, original withal, and full of matter." This is certainly encouraging, and holds out to me the hope that the continual drippings of my pen may in time make impression somewhere, and wear away some of the prejudices against which they are directed. Inveterate errors—errors, moreover of a *respectable* kind, and sanctioned by what passes with the world for paramount authority in all such matters—are not to be exploded in a day, but are rather to be worn away by constant filing. The great thing to be accomplished, if we would advance architecture, is to diffuse a taste for it among the public. For this no stone should be left unturned; nevertheless, it is precisely the very point which is never taken into consideration at all. And why? because none, be they either individuals or societies, feel their own immediate interests concerned in it. It is all very well to string together a parcel of pompous words and phrases about encouragement of art. But it is all moonshine—all gammon! for it has not even the poor merit of sincerity, being no less hollow that it is shallow.

VII. Professor Hosking does not hit the right nail on the head, when he lays so much stress upon the importance of practical knowledge. At any rate, as far as architecture is concerned, it is not there that our deficiency is most apparent. Not a few buildings might be enumerated which, though perfectly irreproachable in respect to construction, are altogether unsatisfactory, absolute nullities and naught, if we consider them as productions of art—and were we not to allow them to be such, their authors would be ready to *Cardigan* us. There are people, nay, professional ones, who affect to hold all that belongs to taste—to the æsthetical part of architecture, as matter of indifference. Possibly they may be sincere—the greater probability is that they are not; but if they are both sincere and consistent, with what utter scorn must they look upon—as what arrant rubbish must they regard, nearly all that has been written upon architecture, whether by Vitruvianists or Palladianists, by Greeks or Anti-Greeks, by Goths or Anti-Goths. How must they in their hearts despise all the wordy strife and contentious babblings and gabblings with which some square miles of paper have been covered!

CHEETHAM CHURCH, &c.

SIR—It is to be hoped that the example set by your correspondent who has furnished the account of the church at Cheetham will be followed by others; for similar descriptions of buildings lately erected or in progress in different parts of the country, would prove valuable information, if only as directing inquiry to what is deserving notice. And since architects themselves are, it seems, very backward in communicating intelligence of the kind, all the more desirable is it that it should be volunteered by other parties. Still, though the description here mentioned is sufficiently full and satisfactory upon the whole, the writer has omitted to state the dimensions of the building, to which he might have helped us by some sort of calculation in round numbers, though he might not be able to tell the precise admeasurements. Neither would it have been amiss had he informed us at what time the church was begun and completed, for both dates and dimensions are rather important items in all architectural descriptions, quite as much so as that of cost, which last, however, seems to be invariably the uppermost consideration of all with Mister John Bull.

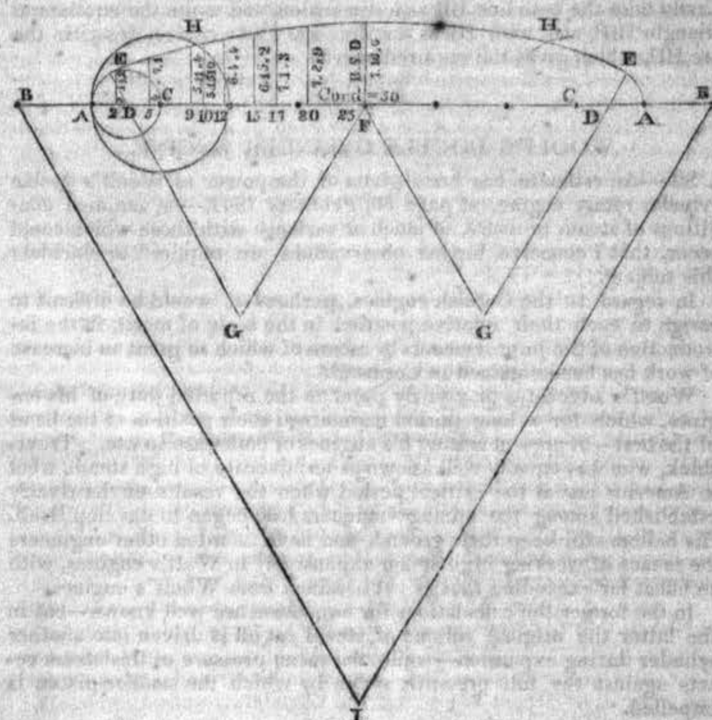
While I thank the writer for his communication, I must say there is one expression which I think he had better have left out, for I can really perceive no modesty whatever in his affecting to call himself "an incompetent person," at the very same time that he adds "architect" to his name; for unless it plainly appears to the contrary, it may be presumed that a professional man is tolerably competent to draw up an architectural description.

H.'s strictures on the "Banks," &c., at Liverpool, contain so much sound criticism, and are written with such spirit and ability, that I sincerely hope you will be able to prevail upon him to extend his observations to other buildings in that town. If he choose to do so, he might probably be able to make some communication relative to the intended "Assize Courts," and "St. George's Hall," both which almost seem to be abandoned, at least for the present. It is, therefore, desirable to know why so much fuss should have been made at all, if nothing is to come of it.

You will think that I am going to review nearly all the articles in your last number, still, I must be allowed to say a word *en passant* to Mr. East, and without expressing my opinion on his paper generally, observe that it would have been not at all less to the purpose, had it specified a few of Campbell's works, and instanced in them those peculiarities which he notices. He might, too, at the same time, have enlightened such blockheads as Candidus and myself, by pointing out in what buildings or designs of Palladio's we are to discover that "grand simplicity and rich excellence"—*risum teneatis!*—which he claims for him. I have spent half a day in looking over a set of his works, yet, hang me if I can find out any thing of the kind in any one of them. Mr. East will, perhaps, say that then I fairly deserve to be hanged without benefit of clergy. I am, therefore, resolved to hang—no, I don't mean to hang myself, but to *suspend*—my pen for the present.

I remain, &c. &c.,
JOHN CROKER.

ON THE CURVATURE OF THE ARCHES OF THE BRIDGE OF THE HOLY TRINITY.



SIR—In looking over some old plans, I fell in with my solution of the curvature of the arches of the bridge of the Holy Trinity at Florence, as far back as January, 1826. I was induced to attempt this solution in consequence of a paper published in the Quaterly Journal of Science, edited at the Royal Institution, by Samuel Ware, Esq., April, 1823, Vol. 15, at the same time having a bridge to erect over the College River, where the situation required a bridge of similar construction.

"ON THE CURVATURE OF THE ARCHES OF THE BRIDGE OF THE HOLY TRINITY AT FLORENCE. BY SAMUEL WARE, ESQ.

"To determine the curvature of the arches of the Most Holy Trinity, erected over the Arno at Florence, by Bartolommeo Ammanati, is a problem which still occupies the attention of antiquaries, mathematicians and architects. Some account of the interest this question has excited will be found in Ferroni's tract, entitled 'Della vera curva degli archi del Ponte a S. Trinita di Firenze; discorso geometrico-storico,' inserted in the 14th vol. of the 'Transactions of the Societa Italiana delle Scienze.

"When it is observed that the curvature of these arches affords the flattest roadway and the greatest waterway, with the smallest quantity of material, of any stone bridge ever constructed; and taking into consideration that cast iron is ten times stronger than marble, and twelve times stronger than common stone in compression, and that the vault of this bridge is less in depth from intrados to the extrados than any iron bridge hitherto built, with relation to the radius of curvature at the vertex, we shall not wonder that the inquiry should be continued until a satisfactory solution be obtained."

The annexed construction gives every ordinate to an extreme exactness when executed with accuracy, as shown by the figures in the annexed diagram. Also the chord of the smaller arch of 45° 16' 4"

by the same construction gives 7° 3′ 5″ as the versed sine. *Vide* Quarterly Journal of Science.

I am, Sir,
Your very obedient servant,
EXPERTUS LOQUI.

Wooler,
26th January.

GEOMETRICAL SOLUTION.

Construction.—The span or chord AA being given, subdivide it accurately into eight equal parts. Add to each extremity of the chord AB also an equal part, the semi-diameter of the piers. Bisect the extreme divisions of the chord AC in D, and with DA as a radius, and D as a centre, describe the circle AEC. Then, from the centre of the chord F to the point D as a dimension, make the equilateral triangle FGD, and continue the line GD to E—E is the point of intersection. Next, with CA as a radius and C as a centre, describe the circle AH; then take AF (one half the chord) as a radius, and G as a centre, describe the arc EH—H is also a point of intersection. Lastly take the base line BB as a dimension, and make the equilateral triangle BIB, and with HI as a radius and I as a centre, describe the arc HH, which gives the required curve.

WOOLF'S DOUBLE CYLINDER ENGINE.

SIR—An estimate has been given of the power of Woolf's double cylinder rotary engine, at page 50, February 1841,—on assumed conditions of steam pressure, so much at variance with those which could occur, that I conceive further observations are required to elucidate this subject.

In regard to the Cornish engines, perhaps it would be difficult to assign to each their relative position in the scale of merit, in the introduction of the improvements by means of which so great an increase of work has been obtained in Cornwall.

Woolf's advocates may fairly point to the reported duty of his engines, which for a long period maintained their position at the head of the best—at present neither his engines or boiler are in use. Trevithick, who was equally well known as an advocate of high steam, went to America just at the critical period when the results of the rivalry established among the mining engineers had began to develop itself. His boilers still keep their ground, and have afforded other engineers the means of working high steam expansively in Watt's engines, with an effect far exceeding that as yet obtained from Woolf's engines.

In the former the calculations for expansion are well known—but in the latter the original volume of steam cut off is driven into another cylinder during expansion—while the mean pressure of this steam reacts against the full pressure steam by which the smaller piston is impelled.

The admission however of the steam into the small cylinder may be cut off at any portion of the stroke, and worked expansively during the remainder, and may then be further expanded in the large cylinder, so that the assertion that "the capacity of the smaller cylinder naturally determines the quantity of steam which the boiler must supply," is untenable.

The only safe assertion respecting the steam pressure in the cylinder would be that it is lower than that in the boiler, and the difference was only considerable, especially in Woolf's practise, from his opinion in favour of wire-drawing high steam, and the small allowance of steam room in his boilers.

Supposing the safety-valve of a boiler loaded with 40 lb. per square inch, it is not probable that the constant total pressure in the cylinder would exceed 40 lb., including atmospheric—that is, 14·75 + 25·25 lb., having a volume of about 670 for one of water. Had the steam been expanded at 40 + 14·75 = 54¾ lb. the volume would have been 520 for one.

During expansion on the given conditions of the respective cylinders, the mean pressure of the steam would be about 17 lb. per square inch on the large piston, with a reaction of 17 lb. per square inch on the smaller piston—against the pressure of 40 lb. full pressure steam on the other side—hence

$$\text{Small cylinder } \frac{207{\cdot}39 \times 40 - 17 \times 176{\cdot}34}{33{,}000} = 25{\cdot}5 \text{ H. P.}$$

$$\text{Large cylinder } \frac{660 \times 17 \times 242}{33{,}000} = \quad 82{\cdot}28$$

Absolute power	- - -	107·78
Friction = ⅓	- - -	35·92
Effective power	- - -	71·86

Taking similar conditions of water evaporation, and cubic feet of steam required, we should have $\frac{16800}{670} = 25$ cubic feet of water per hour, and at 8 lb. of water from 1 lb. of coal, the consumption would be about 2 lb. of coal per horse power per hour.

Numerous causes might produce a consumption of 4 or 4½ lb. of coal per hour, the difficulty would be the reduction of the coal expenditure to the quantity theoretically calculated as sufficient. Instead of low pressure engines, the proper standard for Woolf's, are Watt's engines working high steam expansively, both using similar boilers and coal.

I am not aware of any trials under these conditions, which can be considered conclusive in regard to their relative merits.

I remain, your obedient servant,
Y.

March 11.

CONSUMPTION OF COKE—GLOUCESTER AND BIRMINGHAM RAILWAY.

SIR—In Whishaw's Railways of Great Britain, page 30, there is a statement taken from a paper by Capt. Moorsom relative to the performance of a locomotive engine imported from the United States, that in seven journeys of 596 miles up to Birmingham, the engine conveyed 682 tons gross, and consumed 177 sacks of coke (1½ cwt. each), and in seven journeys of 596 miles down from Birmingham, the same engine conveyed 629 tons gross, and also consumed 177 sacks of coke.

Mr. Whishaw observes, "Thus the consumption of coke, according to this statement, taking the average of the loads up and down, was at the rate of only ·007 lb. per ton per mile!!"

The meaning of Capt. Moorsom's statement seems to be that the engine passed over twice 596 miles with a mean load of 93·64 tons, and consequently her consumption would be ·541 lb. of coke per ton per mile.

It may not be difficult to account for Mr. W.'s erroneous figures; if $\frac{682+629}{2}$ had been the mean load carried, the consumption would have been about ·07; and a mistake in the position of the decimal is not uncommon. I cannot account for the two notes of admiration so readily, as they prove that his attention was called to extraordinary apparent economy of the consumption of coke.

I remain, Sir,
Your obedient servant,
Y.

March 11.

MONUMENT ERECTED AT LIMERICK TO THE MEMORY OF THE LATE VERY REV. DR. HOGAN.

WE were yesterday favoured with a view of the monument just erected in the parish chapel of St. Michael, to the memory of the late very excellent and justly esteemed pastor; and we freely acknowledge that, in classic chasteness of style, correct architectural proportions and superior beauty of execution, the monument surpasses any thing of the kind heretofore seen in this part of the country, and probably not inferior in these qualities to any other specimen of modern sculpture in the Kingdom. The appearance of this memorial to departed worth is at once imposing and elegant, and the eye loves to rest with pleasure on its sublimity of conception, the elaborate beauty of its detail in the various compartments, and the superior finish of the workmanship, from the most minute object to the most prominent, which is a figure of the Archangel Michael. Well may the subscribers be proud of such a lasting record of the virtues of him whom it commemorates, and happy may the highly gifted and eminent artist feel, the production of whose taste and ability it is. Mr. Bardwell, of London, is that gentleman, and at present engaged in the erection of that magnificent edifice, Glenstall Castle, in this county.

It is a mural monument, of Gothic architecture, at the period of the 15th century, and the details are principally taken from the Chapel of Henry VII., in Westminster Abbey; also, from the Chapel of Magdalen College, Oxford. The monument, which partakes somewhat of the character of a shrine, is apparently borne aloft, or supported, by four angels, correctly copied from the works of Wainfleet, Bishop of Winchester, and founder of Magdalen College. One of the angels bears a shield, another a book, another a censer, and the other a lily—this last, which is particularly beautiful and true to nature, was a favourite emblem of Wainfleet's, and figures in many parts of Magdalen College. The design consists of three compartments, divided by boldly projecting buttresses terminating in richly crocketted finials, subdivided by rich and elaborate tracery into smaller ones. The whole design may indeed be considered allegorical, consisting of a number of beautiful figures, each having reference to the spiritual duties and pious characteristics

of the deceased clergyman. For example, one of the figures represents St. Peter as Prince of the Apostles; another St. Patrick, the patron of Ireland; another St. Roche, a figure emblematical of our short pilgrimage in this world; while the patron saint of the chapel in which it stands, and in which the deceased officiated for 26 years, occupies the centre compartment, exhibiting a drapery containing the inscription.

The exquisite beauty of this figure is remarkable and is worthy of earnest attention, the spreading pinions, the calm angelic sweetness and dignity of the countenance, and the serpent writhing in agony beneath his foot crushed to the earth by his delegated power, all unite to form a combination of grace, elegance, and skill in design and execution which cannot fail of raising in the mind of the spectator the highest admiration. The accuracy and ability displayed in the portraiture of the serpent, especially about the head, are wonderful; in the three niches at the other side are two figures of alcolites, one bearing wine and the other bread, and in the other the figure of a mitred abbot in his ecclesiastical costume, to continue the allegory as to the station and rank of the deceased. Over these objects, the cornices are most elaborately sculptured and crowned by a rich border, with the usual finish of the period, a strawberry leaf and ball, with the Tudor flower interspersed. The monument, which is all of the purest white Italian marble, is projected on a magnificent black slab, 13 feet by 7, from the Ballysimon quarry, in the neighbourhood of this city, and its erection has been, this day, completed by Mr. Garvey, of Catherine Street, under the direction of the artist, Mr. Bardwell, who has been most particular in seeing to its security and completion. —*Limerick Chronicle.*

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES AND PADDLE SHAFTS.

Henry Trewhitt, of Newcastle-upon-Tyne, Esq., for improvements in applying the power of steam-engines to paddle-shafts used in propelling vessels. Enrolment-office, February 7, 1841.

These improvements consist in a new method of applying the crank-pin of paddle-shafts, so that one or both of the paddles may be disconnected or connected with the engine with great facility. For this purpose there is on each of the paddle-shafts a narrow cylinder, with a groove on its periphery, to receive a strap which is attached to the crank-pin that drives the paddle-shaft. The other end of the crank-pin is keyed into the crank of the middle shaft. In order to connect the paddle-wheel with the engine, the strap is made to bind tightly upon the narrow cylinder, and is disconnected by being loosened, in the following manner. A cross-head passes through slits in the end of the strap, and is fastened to a cushion resting on the narrow cylinder, and curved on its under surface so as exactly to fit. When the paddle-shaft is to be connected to the engine, the cushion is made to press upon the narrow cylinder by a wedge-shaped bar, which enters between the back of the cushion and the cross-head; this causes the strap to bind tightly upon the cylinder, and forms the connection required. On withdrawing the wedge-shaped bar, the strap becomes loosened and the paddle-shaft is disconnected from the engine. The claim is to the mode described of applying the crank-pins to paddle-shafts.—*Mechanics' Magazine.*

IMPROVEMENTS IN RAILWAY WHEELS, RAILS, AND CHAIRS.

Andrew Smith, of Princes-street, Leicester-square, and of Mill-wall, Poplar, Engineer, for certain improvements in carriage wheels, rails, and chairs, for railways. Enrolment-office, February 7, 1841.

The improvement in wheels consists in the application of a wrought iron tire, having a right-angled groove turned out in the middle, corresponding to the rail which constitutes the second part of these improvements. The depth of this groove is to be proportionate to the size of the rail, and forms a flange within the surface of the tire, tending to keep the wheel in its place upon the rail. The rails are square bars of iron, the sides of the squares being about one-third wider than the depth of the sides of the groove in the tire of the wheels, for the purpose of preventing the wheels from coming in contact with the chairs and sleepers. These rails are laid in grooves cut in wooden sleepers, and present one of the angles of the square upwards, corresponding with the angular groove in the tire of the wheel. The chairs are made of wrought or cast iron; they clip the sides of the rails in a dove-tail form; and are let into and bolted down to the wooden sleepers. The rails are each 12 feet long, by 2¼ inches square, and the chairs are placed in the middle and at the junctions of each rail. The claim is, 1. The right-angled grooves in the tires of the wheels of railway carriages, instead of an external flange.—2. The adaptation of common square bar iron, or of iron made in a square form, let into a wooden sleeper.—3. The chair, for connecting, and fixing, and fastening the rails.—*Ibid.*

IMPROVEMENTS IN LIME AND CEMENT.

Charles Smith of Exeter, Devon, builder, for improvements in the manufacture of lime and cement, or composition. Enrolment-office, February 27.

Claim first.—The mode of calcining lime or cement, or composition, by means of kilns, so formed, that the charge in the upper part shall be calcining, whilst the lower part of the charge is cooling; and in cooling, the heat therefrom passes to the upper part of the kiln.

The heat from coke ovens, furnaces, &c., is admitted into the kiln by flues which enter the kiln half its height from the ground, and the heat rising upwards calcines the upper part of the charge; whilst the lower part of the charge which has been calcined, is cooling, the heat arising from it assists in the calcination of the upper part. The lower part of the charge as it cools is raked out at the bottom of the kiln, and the upper part descending, fresh lime is added at the top of the kiln.

Claim second.—The mode of calcining lime and cements in retorts or ovens when in connection with a closed chamber, where the matters can be cooled before being brought into the atmosphere, and also the carrying off the gases or vapours, so as to apply them to a variety of useful purposes. The lime and cements are calcined in ovens which communicate with a closed chamber, in which the lime and cements, after being calcined, are cooled before they are brought into the atmosphere. The gases or vapours are carried off from the ovens by pipes provided with stop-cocks, into suitable vessels provided for receiving them.

Claim third.—The application of the heat of lime-kilns to the purposes of evaporating fluids in suitable boilers or pans, as herein described. The heat arising from the kiln is applied by means of flues to the heating of boilers or pans for evaporating fluids.

Claim fourth.—The mode of slacking lime in chambers with carbonic acid as herein described. The lime is slacked in a chamber, into which the carbonic acid arising from the kiln is admitted by means of valves communicating with the flue.

Claim fifth.—The mode of manufacturing lime by re-calcining it after dry slacking. The lime after being slacked as above described, is placed in the oven and again calcined.

Claim sixth.—The mode of manufacturing lime by partially calcining limestone in a kiln in order to convert it into sub-carbonate, and after cooling and grinding again to calcine it, whether separate, or combined with other matters, for making cement. This claim fully describes itself.

Claim seventh.—The mode of making cement by saturating sulphate of lime with ammoniated liquid, or other matters, as herein described. The patentee grinds sulphate of lime, or gypsum, into a powder, and covers the floor of the oven three inches thick with it. The oven is then closed, and the charge remains for four hours. It is then placed in a cistern and covered with purified liquor prepared from the ammoniated fluid formed in the manufacture of coal gas, commonly called gas water. When completely saturated it is spread over the floor of the oven and dried. It is then taken out, and a fifth part of slacked lime is added to it, after which it is ground and placed in the oven for the same time as before. It is then fit for use.

Claim eighth.—The combining lime and cements with ground calcareous matter, or stones, in substitution, or in aid of, silex, or other matter. The lime is mixed with ground calcareous matter, and burnt in the oven, after which it is fit for use.

Claim ninth.—The mode of preparing lime for use by applying soap, with or without glutinous matter, and also the method of using hot tools for finishing and polishing cemented surfaces. Two parts of ground marble are mixed with one part of fine slacked or ground lime, with the least quantity of water possible. This is done two or three days previous to using the same, but it is tempered once or twice a day with a beater or other tool. The patentee next takes one pound of soap, and dissolves it over a slow fire in about six quarts of water, occasionally adding two ounces of glue or other glutinous matter to the same, by which means the cement is rendered more tenacious. He takes the composition prepared as above, and adds to it the colour, to form the tint required for the ground colour, and brings it to the consistence for use by pouring into it the soapy solution, mixing it well, and applying it in the manner that stucco is at present done. When it is done a highly burnished hot metal tool is passed over the surface, which will unite the whole, and form a good polish.

Claim tenth.—The mode of preparing cement from lime, by means of oil and water, with or without other materials, as herein described. To any number of gallons of clean water add as much fresh burnt lime as will when slacked bring it to a semi-fluid consistency. When it is half slacked add as many quarts of oil as there are gallons of water, and stir this well together until the whole is properly mixed. Then strain it through a fine sieve, and when cool it is fit for use. It is applied in the same manner as when plastering with stucco.

Claim eleventh.—The combining aluminous earths and ground clinkers, or slag, or scoria, from the smelting furnaces; and the forming and burning of tiles thereof. Also the forming of tiles or burnt rough surfaces to be used in substitution of laths, to receive cemented surfaces as herein described. The tiles are made of three parts good aluminous earthy matter, mixed with one part of ground clinkers &c., from the smelting furnaces, and when properly tempered they are made, dried, and burnt in the same manner as roofing tiles. They are made rough on one side so that the composition applied may adhere freely in the same manner as the pricking up coat, thus serving the double purposes of laths and the pricking up coat.

Claim twelfth.—The mode of treating articles made of lime or cement, and calcareous stone or earth, by placing them in chambers with carbonic acid. The articles previously wetted with lime water are placed in the chamber

mentioned in the fourth claim, and exposed to the action of the carbonic acid, by which they acquire great hardness.—*Inventors' Advocate*.

STEAM ENGINE REGULATOR.

Benjamin Hick, jun., of Bolton le Moors, Lancashire, engineer, for certain improvements in regulators or governors, for regulating or adjusting the speed or rotary motion of steam-engines, water-wheels, and other machinery. Entered at the Petty Bag-office, February 27.

This improved governor is applied to the throttle valve of steam engines, in place of the ordinary pendulum governor. The ordinary iron standard or frame of the governor, is placed as usual over the crank shaft of the engine, on which is fastened a bevel wheel that drives a pinion attached to an upright spindle or shaft; by this means a rotary motion is communicated to the spindle, which revolves in suitable bearings in the frame. The upper part of this spindle is cut into a screw, on which a bush or nut, having an internal screw, works; this bush, having two arms extending from it, to each of which is attached a vane; and the bush is connected to the throttle valve of the engine by links and a swivel, and connecting rods and levers, in the usual manner. If the crank shaft overruns or increases its ordinary velocity, it will cause the bush to rise up the spindle, and by means of the connecting rods and levers, partially close the throttle valve; on the contrary, if the crank shaft decreases its ordinary velocity, the bush will descend, and so open the throttle valve wider, in order to admit an additional quantity of steam to the engine. The patentee does not confine himself to the above, as the parts may be varied to suit circumstances.—*Ibid.*

APPARATUS FOR PREVENTING SHIPWRECK.

A few months since we gave an account of an interesting attempt made by Mr. Page, the superintendent of our Harbour Works, for simplifying Captain Manby's plan for relieving vessels in danger of shipwreck. It is with the greatest pleasure that we have to state that Mr. Page has *tested* the value of his efforts by saving a vessel, to all appearance, destined to inevitable destruction. About one o'clock P. M., of the 13th of February, the schooner *Leighton*, Jones, master, was seen making for this port, and driving with a heavy sea right for the north side of the harbour, where we have witnessed many a wreck with loss of life and property. The sea being at this time so heavy, and the boat, with the pier rope, being unable to get through, in consequence of the surf, the vessel struck on the North Bank. The situation of the vessel was now so critical, and the breakers surrounding so violent, that no boat attempting to relieve her could live. Under these circumstances, Mr. Page brought the twelve pounder belonging to the Harbour Works to bear upon her, and at the first discharge, succeeded in conveying a rope across the breakers, which passed fairly over her rigging. To this rope, a hawser was fastened by those on the pier, which, being hauled by the crew on board, sufficiently steadied her, and the result was the vessel was saved. We feel it our duty to give publicity to this circumstance, feeling perfectly confident that were it not for the rope conveyed by the carronade, she would either have been a wreck, or have received considerable damage. James Davies, Esq., the owner, was present, and seemed not a little pleased at the result of the first trial of Mr. Page's experiment.—*Carmarthen Journal.*

Since the appearance of the above paragraph, the above plan has been again adopted with complete success, but with such variation, as to give it additional value, by showing the versality of its application. On the 23rd ult., the schooner *Nanteos*, Griffiths, from London, appeared before this port, but the breakers were so high, that it was impossible for any boat to go out to assist her in. On this occasion the *carronade* was fired from off the pier, which carried the *plug* beyond the breakers,—this was picked up by the boat from the Nanteos, and a communication was immediately made with the shore, and the vessel came in without any difficulty.

The advantage of the *plug* over a *shot*, may be seen on occasions like the present,—had this been a *shot* connected with the line, it would have sunk, but the *plug* floated, and was easily picked up by the boat from the Nanteos.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Annual Report.

The Council of the Institution of Civil Engineers, on resigning the trust which has been confided to them during the past year, invite the attention of the Annual General Meeting, and of all who are interested in the progress of practical science, to the following report on the discharge of their various duties, and on the general nature of the proceedings of the past year.

The annual report of the council of several preceding years has dwelt in considerable detail not only on alterations in the ordinary business of the Institution, and on the introduction of measures which might tend to the convenience of the general body, but also on changes of a more important character, affecting the constitution and permanent stability of the Institution itself. The year which has now past has not been marked by any features of this nature. The principal duty of the council has been to carry out and persevere in the practice and regulations established during previous years, which have been found to contribute so much to the rapid growth and increasing value of the Institution.

But, though the past year may not have been marked by extensive changes or by the introduction of new regulations, it has been characterised by events of great interest, and the proceedings of the last session surpass in extent those of any previous year. The extended importance of the Institution has imposed an augmentation of duty and responsibility on your council, and they have laboured so to direct the affairs intrusted to them, that the discharge of those increased duties might be attended with a corresponding elevation in the character of the Institution, and that their successors in office may realize a still further progress towards that eminence which is already in some measure attained.

Among the various duties which devolve on your council, that of disposing and awarding the Telford premiums is of the highest consequence, and on the proper discharge of which much of the permanent success of the Institution will depend. The council, deeply impressed with this, have given their most careful consideration to the subject; they would direct your attention to the following notice of the premiums, and of the respective communications for which they have been awarded.

In the annual report of the last session, the council stated that it would be one of the earliest duties of their successors, to consider in what manner the benefits conferred by your member Mr. Parkes on practical science, by the communications then alluded to, could be most appropriately acknowledged; and the present council, concurring most fully in these sentiments, are of opinion that as no papers have hitherto been received by the Institution, exhibiting so much originality, labour, and ingenuity, in dealing with the facts presented to his notice, combined so essentially with practical utility, they are warranted in conferring on Mr. Parkes the highest honour which the Institution has in its power to bestow. They have awarded, therefore, the Telford Gold Medal to Mr. Parkes, for his communications on "Steam Boilers and Steam Engines," which are now published in the first and second parts of the third volume of the transactions. These papers and the discussions to which they gave rise, occupying as they did the attention of several of your meetings, together with the interest which they excited, must be fresh in the recollection of all who were present. It will, therefore, be unnecessary to dwell particularly on their contents; but, inasmuch as the highest honour of the Institution has been awarded to them, an honour which (it must be remembered) has been but once previously conferred, the council feel it to be a duty which they owe to the Institution, to themselves, and to the public, no less than to the author, to point out (as has been partially done in the report of the last year) some of the principal features in these communications, and the peculiar benefits which are thereby conferred on practical science.

These communications are the continuation of the labours of the author, which commenced with the paper on the "Evaporation of Water from Steam Boilers," published in the second volume of the transactions, and for which a silver medal was awarded on a previous occasion. The first communication, forming the subject of the present notice, relates especially to steam boilers, respecting which many well-ascertained facts had been collected; but previously to Mr. Parkes devoting his attention to this subject, no clear and connected view had been given of the various facts, or of their relation to each other, and to the circumstances under which they are exhibited. When so represented, it appears that the peculiar circumstances under which steam boilers are employed and their corresponding qualities and characteristics in respect of construction, proportion of parts, and practical management, present certain quantities and relations, which exert a peculiar influence over the results connected with evaporation; and these being clearly developed and understood, indicate correctly the character of the boiler. Certain definite quantities, relations, or exponents, with other facts of paramount importance, such as the effect of the element time, or the period of the detention of the heat about the boiler, and various actions independent of the temperature of the fire, and tending to the destruction of the boiler, are here for the first time pressed on the attention of the practical engineer. In the second communication, the author traces the distribution and application of steam in several classes of steam engines. In the execution of this task, he is led into a detailed examination of various important questions: the best practical measure of the dynamic efficiency of steam—the methods employed to determine the power of engines—the measures of effect—the expenditure of power—the proportions of boilers to engines—the standard measure of duty—the constituent heat of steam—the locomotive engine—the blast and the resistance occasioned by it—the momentum of the engine and train, as exhibiting the whole useful effort exerted by the steam—and the relative expenditure of power for a given effect, by fixed and locomotive non-condensing engines. The bare enumeration of the principal subjects which have been carefully analysed and illustrated by the facts applicable to each respective case, will give some idea of the magnitude of the task here undertaken; and when, in addition, is considered the elaborate and extensive series of tables exhibiting the results and analysis of the facts collected and used in the course of the inquiry, the council cannot but feel that a more laborious task

has rarely been accomplished. A peculiar feature of these communications, and one to which the council would particularly advert, is, that they are not of a speculative character, but present a detailed analysis of authenticated facts.

This analysis consists in separating and ascertaining the various results, and in referring them to particular classes, so that they may be readily applicable in practice. The merit of instituting and recording a series of observations upon a scientific subject is universally acknowledged, but the reduction of such observations so as to form a standard of reference to which the practical engineer may appeal, is a task of far greater difficulty, and its execution of far higher merit. It is in this eminent rank that the council would place these communications of Mr. Parkes.

The description by Mr. Leslie of the Harbour and Docks of Dundee, was also briefly adverted to in the last annual report, as one of those communications on which the Institution sets great value. It consists of a detailed account of the progress of the improvements projected by Smeaton, Telford, and others, in part carried into execution by the projectors, and completed under the author's own superintendence since 1832. The illustrations of the projected and executed improvements with the plans, elevations, sections, and details of the works of the docks, gates, quays, cranes, and machinery employed, occupy 36 sheets of drawings. To the copious history and description of these works is added an extensive series of observations on the tides. The determination of these facts for different parts of the globe, is a question of the greatest importance in physical astronomy, and the council would take this opportunity of pointing out the essential service which may thus be rendered by the engineer to the cause of science by his recording the observations which *he* has pre-eminently the opportunity of making. For this valuable record of an executed work, the council have awarded a silver medal, and a copy of the life and works of Telford.

A silver medal and the life and works of Telford have been awarded to your associate, Robert Mallet, for his communication on the "Corrosion of Cast and Wrought Iron in Water." This communication presents features of no ordinary interest to the engineer. The comparatively recent introduction of cast iron for the purpose of piling, for wharfs, &c., and of wrought iron in the construction of vessels, has rendered the subject of the action of water upon iron of peculiar importance; the British Association have, from time to time, granted sums of money for making experiments on this subject, and Mr. Mallet having been engaged in conducting these experiments, has selected from the very extensive series of results obtained by him, these conclusions which may be of service to the practical engineer. The most valuable portion of this communication consists of elaborate tables, which exhibit the results of the action of clear and foul sea and fresh water at different temperatures upon cast and wrought iron. Such being the general nature of the experiments, the results to which they lead, or the effects produced, present several remarkable characteristics, and it is found that the corrosive action of water and air combined, produces, on the surface of cast or wrought iron, a state of rust possessing one of five distinctive features, viz. uniform—uniform with plumbago—local—local pitted—tubercular; or some two or more of these in partial combination. The practical results which may be deduced from these tables are of the highest value to the engineer, and point to considerations of the greatest importance; thus the upper and lower strata of water, of different degrees of saltness and density, coming in contact with the same mass of iron, a voltaic pile of one solid and two fluid elements is formed, and under such circumstances the corrosive action is materially augmented; hence it follows as a practical conclusion, that the lower part of all castings used in such situations, should be of increased dimensions. Similar results, the knowledge of which is of great importance to the practical engineer, such as the rapid decay of iron in the sewage of large cities, of the bolts of marine engines exposed to the bilge water, and of boilers containing hot sea water, are referred to actions due to similar physical principles. The protection which metals receive from paint, or from the presence of various alloys, so as to obtain a mode of electro-chemical protection, such that, while the metal iron shall be preserved, the protector shall not be acted upon, is also referred to similar principles.

The council have also awarded a bronze medal and books to Mr. Charles Bourns, for his communication on "setting out railway curves;" to Mr. Chapman, for his description and drawings of "a machine for describing the profile of a road," and to Mr. Henry Renton, for his description and drawing of "a self-acting Waste-board on the River Ouse."

The communication by Mr. Bourns is an application of simple geometry, leading to practical results. In setting out curves recourse has been had to various expedients, but Mr. Bourns, in the propositions contained in this paper, has shown that, by the use of the common chain, an offset staff, and table of offsets, he is enabled to set out curves of any radius and flexure, with a facility and precision not generally attained.

The description and drawings of a machine for describing the profile of a road, is one of several communications on this subject, sent in accordance with the notice of subjects for competition issued by the council. Many of the arrangements proposed by the author exhibit considerable ingenuity, and though difficulties may exist in their practical application, the council think this attempt may be of assistance to others, who may have their attention directed to the construction of an instrument for similar purposes.

The description and drawing of the self-acting waste-board on the river Ouse, being an account of an executed work, is one of those communications which the council are most anxious to encourage by every means in their power. The drawing and description furnished by Mr. Renton are highly creditable to the talents of the author, and deserving of some special mark of approbation.

The council have also awarded books to the value of five guineas to Eugenius Birch, for his drawing and description of the machine for sewing flat ropes, in use at Huddart's rope manufactory. The rope machinery of Captain Huddart was, some time since, one of the subjects on which the council solicited communications; on that occasion two valuable sets of drawings were communicated, the one by Mr. Dempsey, the other by Mr. Birch. The subject of the present communication was not included in either of the preceding, but Mr. Birch, desirous of availing himself to the fullest extent of the liberality of Mr. Cotton, the then proprietor of the machinery, and of carrying out the views of the council, has devoted much time and labour to placing in the Institution, an exact record of every thing connected with this interesting machinery.

Premiums of books have also been awarded to Mr. Maude, for his "Account of the Repairs and Alterations made in the construction of the Menai Bridge, rendered necessary by the gale of January 7, 1839," and to Mr. Andrew Burn, for his drawings of a "Proposed Suspension Bridge over the Haslar Lake." The council would point out these instances of the fulfilment of the engagements entered into on election, to the attention of the other graduates of the Institution, who have similar opportunities, but who have not hitherto kept their promises. It is the desire of the council to obtain an exact record of works that are projected or in progress, and such records are peculiarly adapted to compete for the Telford premiums; Mr. Maude and Mr. Burn, with proper permission, have availed themselves of the facilities afforded them, and the council trust that the premiums now awarded, and the marks of approbation here expressed, will stimulate others to avail themselves of like opportunities. The authors of such communications will thus most materially contribute towards promoting the interests of the Institution, and to their own qualification for future employment and advancement in the profession.

The Institution has received during the past year, many other communications of acknowledged merit, of which no mention has yet been made. To a few of them the council would now briefly advert, and especially to the last paper by Mr. Parkes, "On the action of Steam in the Cornish Single Pumping Engine," a communication of no ordinary importance and interest, either on account of its own intrinsic merits, as viewed in connexion with the past proceedings of this Institution, or the future pospects of this department of practical science. This communication, though intimately connected with those of the same author previously alluded to, growing immediately out of them, and depending upon the facts contained in them, is of a totally distinct character; being an attempt to explain, on theoretical principles, the action of the steam on the piston, and to unfold the real causes of the economy of the Cornish engines. This subject has occupied the attention of the Institution during the last four years, and the discussion first assumed a settled form during the session of 1837, on the receipt of the communication of Mr. George Holworthy Palmer, "On the application of Steam as a moving power, especially with reference to the reported duties of the Cornish and other Engines." In that paper the author, reasoning on certain data as to evaporation, and on the physical facts which involved the constancy of the sum of the latent and sensible heat in steam of all elasticities, and of the absorption of heat by matter on dilatation, came to the conclusion that no power could be gained by expansive working, and that, consequently, this could not be the *cause* of the economy in Cornish engines. This discussion was revived in the ensuing session by the communications of Mr. Wicksteed and Mr. Henwood, the former furnishing the first recorded experiment in which the water raised was actually weighed, the latter giving an extended series of most careful and detailed observations on the quantity of steam employed, the mode of its distribution, the duty performed by a given quantity of fuel, and the measurement of the water raised.

Taking for data the facts furnished by Mr. Henwood for the Wheal Towan, and by Mr. West for the Fowey Consols Engines, Mr. Parkes has analyzed the quantity of action obtainable from the quantity of water as steam consumed, and expanded to the extent used in those engines, and has found the steam's force unequal to the resistance overcome. After satisfying himself from various phenomena attendant on the working of these engines, that the amount of resistance opposed to the steam was not overrated, he was led to conclude that from the instantaneous and free communication effected between the cylinder and boiler of these engines, by the sudden opening of the large steam valves, a force must be transmitted to the piston, of a kind distinct from that of the steam's simple elasticity. This force he denominates the steam's *percussive action*; he adduces various proofs that this description of force has operated on the piston, and that it alone was equivalent, in the instance of the Fowey Consols Engine, to drive the piston through $\frac{37}{100}$ths of its stroke.

The author considers the effect produced on the piston of a Cornish Engine, by the sudden impact of highly elastic steam, to be similar to that obtained from water in the hydraulic ram. He has not in his paper entered on the consideration of the absolute amount of percussive force, which can be afforded by an aeriform fluid in motion—but has confined himself to the determination of the quantity of action, which he conceives to have been derived from that source in the particular engines examined. He invites the co-operation of others in instituting experiments on this subject, and the Council hope that the ensuing Session will augment the number of facts re-

quisite for the complete demonstration and development of this view of the steam's action.

It is gratifying to reflect how much the present state of our knowledge is due to the discussions which have taken place at the meetings of the Institution. The Council look forward with great interest to the revival of these discussions, and for some valuable communications on this subject which are promised by Members who have daily opportunities of making observations and experiments on an extensive scale.

Among the other communications, the Council would briefly advert to that by Captain Basil Hall, on obtaining for Lighthouses all the advantages of a fixed light, by means of refracting lenses in revolution. It occurred to that distinguished officer that by placing a Fresnel lamp in the centre of an octagonal frame, having a lens inserted in every side, and causing the frame to revolve at a considerable velocity, a fixed or continuous light would be produced almost equal in brilliancy to the intermittent light from the same lamp when the frame revolved slowly.

Many curious effects are observed; thus, when the lenses are first set in motion the effect is a series of brilliant flashes; as the velocity increases, the light becomes more continuous—at about 44 revolutions per minute, absolute continuity is produced—and at 60 revolutions nearly the steadiness of a fixed light is attained. It would appear that the sensibility of the retina is affected by the succession of bright flashes, so that, judging by its intensity when seen through coloured glasses, the light would appear to suffer but little apparent diminution.

Another subject rather novel in its nature, but of considerable interest to the profession, on the "Application of Photography to the purposes of Engineering," was brought before the Institution, by your Member, Mr. Alexander Gordon. The facility with which this discovery may be applied to taking accurate views of buildings, works, or machinery at rest, renders it an object of great interest to Engineers; since by these means may be obtained the general dimensions of works, with perfect accuracy in a very small space of time, and by affixing a graduated scale to the objects to be copied, the photographic delineation would present the means of determining the dimensions of every part.

The Council cannot omit this opportunity of acknowledging the obligations which the Institution is under to Mr. Cooper and Mr. Cooper, Jun., who illustrated the preceding communication by exhibiting and explaining the apparatus requisite for the production of the delineations of photography.

The Council have to acknowledge the receipt of many valuable presents during the past year; and to record the liberality and zeal thus exhibited in the promotion of the interests of the Institution.

By the liberality of your President and of Mr. Burges, you are in possession of two portraits upon which every British Engineer must look with feelings of great pride and satisfaction. To the President you owe the beautiful portrait of Huddart, now suspended in your Meeting Room, and to Mr. Burges that of Smeaton, which adorns the walls of the Library.

The Institution has to acknowledge the continuation of the liberality of the Master-General of the Ordnance, of the Lord Lieutenant of Ireland, and of Colonel Colby, in transmitting the sets of Ordnance Maps as they are published.

The Council has also to acknowledge the receipt of some additional works from the library of the late Dr. Young, presented by his brother, Mr. Robert Young, whose liberality in making the Institution the depository of a large number of the works of that distinguished philosopher and benefactor to practical science, the Council of the preceding year had also to record in a similar manner. The Institution has also received a valuable set of Charts of the Coast of France, published under the direction of the French Government, from your President; a number of books from the Minister of Public Works at Brussels, collected by your Secretary during a recent visit to Holland and Belgium, when a communication was established between the Institution and the Ministry of Public Works of those countries; the Transactions of the Royal Institute of Naples from Colonel Cuciniello, through Mr. Albano; a valuable set of Crane Drawings from Mr. Leslie, and Drawings of the Carn Brae Stamping Engines from Mr. Sims, through Mr. Enys; some interesting models from Mr. Hick, a Pneumatic Mirror of his invention from Mr. Nasmyth, and a Radiating Stove Grate for the Library, from Mr. Sylvester; to these must be added the very numerous List contained in the Appendix to this Report.

The Institution has to regret the loss by death, of Mr. Francis Bramah, Mr. Oldham, Mr. Rowles, and Mr. Rickman; individuals distinguished for their attainments in professional and general knowledge, and endeared to the Institution by long association and deep attachment to its interests.

Francis Bramah was the second son of the late Mr. Joseph Bramah whose numerous inventions, perfection of workmanship, and genius in the mechanical arts, have rendered his name so widely and justly celebrated. The opportunities afforded to the son were ardently embraced by a mind of no ordinary powers, deeply imbued with the love of knowledge. Although his attention was in early youth more particularly directed to branches of minute mechanical construction, his acquaintance with the principal departments of professional knowledge and general science was very extensive. His attachment to the arts and to science was deep and sincere, and among many proofs of this may be particularly mentioned the valuable and essential services which he rendered to your late Honorary Member, Thomas Tredgold, both in his professional pursuits and in the prosecution and verification of his theories and calculations. Mr. Bramah being professionally engaged at Buckingham Palace, in connexion with some other engineers, difference in opinion existed and discussion arose, as to the true principle upon which the strength of cast-iron beams to resist stress and flexure ought to be estimated, and with the view of verifying the principles laid down by Tredgold, he instituted a very extended series of experiments, on the deflection and strength of cast iron beams. These he presented to the Institution, and they are published in the second volume of your Transactions.

Several important works were executed under his direction, among which the iron work of the Waterloo Gallery at Windsor Castle, the cranks, the lock-gates, and their requisite machinery, at the St. Katherine's Docks, and the massive gates at Constitution Hill and Buckingham Palace, may be particularly mentioned. Mr. Bramah was an early and deeply-attached member of this Institution; his constant attendance at the meetings, the information which he communicated, and his unwearied zeal as a member of the council, cannot be too highly estimated, and his loss will be deeply felt and regretted within these walls. The variety of his attainments, his refined taste in the arts, his amiable character and the warmth of his affections, had secured to him the respect and esteem of a most extensive circle of friends, by whom, as indeed by all in any way connected with him, his loss will be most deeply and sincerely felt.

John Oldham, the engineer of the Banks of England and Ireland, was born in Dublin, where he served an apprenticeship to the business of an engraver, which he practised for some time, but subsequently quitted to become a miniature painter, wherein he acquired some reputation. He pursued this branch of the arts for many years, but having a strong bias towards mechanical pursuits, he devoted much of his leisure time to the acquisition of that knowledge which was to prove the foundation of his future celebrity. In the year 1812 he proposed to the Bank of Ireland his system of mechanical numbering and dating the notes, and on this being accepted, he became the chief engraver and engineer to that establishment. The period of twenty-two years, during which he held this appointment, was marked by continually progressive steps of artistical and mechanical ingenuity. The various arrangements which he projected and carried out attracted great attention, and conferred considerable celebrity on the establishment with which he was connected.

The late Governor of the Bank of England, Mr. T. A. Curtis, had his attention directed to these important improvements, and under his influence the whole system of engraving and printing, as pursued in the Bank of Ireland, was introduced into the national establishment of this country, under the superintendence of its author, who continued in the service of the Bank until his death.

The ingenuity of Mr. Oldham was directed to other objects, especially to a system of ventilation, of which an account was given by the author during the session of 1837. Great versatility of inventive faculty, persevering industry, and social qualities of the highest order, were the prominent features in his character, and the success which attended his exertions is one of the many gratifying instances to be found in the history of this country, of talents and industry, destitute of patronage attaining to eminence in the professions to which they are devoted.

Henry Rowles, the chairman of the Rymney Iron Works, was educated in the office of his relative, Mr. H. Holland, the architect, on quitting which he entered into business as a builder. He was engaged, among other extensive undertakings, in building several of the East India Company's Warehouses, the Royal Mint, the Excise Office, and Drury Lane Theatre. He was an active Director in several docks, railway, and other companies, and finally became managing director of the Rymney Iron Works, in the active discharge of the duties of which office he continued until his death. The Institution owes to him the drawings of the iron works made by Mr. Richards.

John Rickman was educated at Lincoln College, Oxford, and graduated there; he subsequently devoted himself to literary pursuits, to political economy, and to practical mechanics. For some years he was conductor and principal contributor to the "Agricultural and Commercial Magazine." In 1801 he removed to Dublin, as Private Secretary to the Right Hon. Charles Abbot, then Keeper of his Majesty's Privy Seal in Ireland. Upon the election of Mr. Abbot to the Speaker's Chair in the House of Commons, Mr. Rickman continued to be his private secretary, and in 1814 he was appointed to the table of the House of Commons. He also acted as secretary to the two commissioners appointed by act of parliament in 1803, "for the making of roads and bridges in Scotland, and for the construction of the Caledonian Canal," and to the commissioners "for building Churches in the Highlands." The ability and energy which he displayed in the discharge and conduct of the duties of these laborious offices, for more than thirty years, in addition to his constant attendance at the House of Commons, called forth the warmest acknowledgments of public meetings held in the Scotch counties on his retirement, and various resolutions were passed expressive of the sense entertained of the unremitting exertions, and uniform and disinterested assiduity, with which he had promoted every object connected with the improvement and general prosperity of the Highlands and Isles of Scotland. The conduct of the affairs of the Highland Commissioners brought Mr. Rickman into constant intercourse with their engineer, Mr. Telford; an intimate friendship was formed between them, and Mr. Rickman completed and published the account of the life and works of that eminent man, which was but partially arranged at the time of his decease.

Mr. Rickman's chief work is the Census of Great Britain, in six folio volumes; he is also the author of numerous papers connected with statistics,

having bestowed great pains in collecting and arranging the returns connected with education and local taxation. To this Institution he rendered very essential services, and whenever application was made to him in its behalf, was always zealous in endeavouring to promote its interests. The library was enriched by him with two copies of the Life and Works of Telford, and as the acting executor of Telford, he endeavoured to carry out, by every means in his power, the intentions of that great benefactor of the Institution.

Mr. Rickman's acquirements in every department of knowledge were accurate and extensive; to great quickness of perception, and memory of no ordinary power, were added indefatigable industry, undeviating method, and a sound critical judgment;—qualities which caused his acquaintance to be highly valued by the most distinguished literary characters of the day, and which, no less than the strict and scrupulous sense of justice and honour, which particularly showed itself in his considerate kindness towards all those with whom he was connected, will occasion his loss to be deeply regretted by a widely extended circle.

Address of the President.

Allow me to thank you for the compliment you have again paid me, by electing me your President for this current year.

The Secretary has reminded me, that I have been in the habit of addressing you on occasions corresponding with the present, but the very full, and I believe I may say, satisfactory Report of your late Council, has left but little for me to say on the business of the Institution. Your new Council have elected Mr. Manby for Secretary, Mr. Gibbon for Collector, and Mr. Hankey for Treasurer. We have the test of long experience in favour of the Collector and Treasurer, and although our acquaintance with your Secretary is shorter in point of time, we are all convinced that his whole attention and energies will be, as indeed they hitherto have been, devoted to the Institution.

Hitherto the increased number of our Members, and the attendance at the meetings during each year, have been commensurate with the growing importance of the Institution, and I have little doubt of the success of the present Session being still greater. We have under consideration several interesting subjects, to which some of our most active Members have paid great attention, and in which they have made important discoveries—these will form the ground-work of interesting and instructive conversation, or even, to use the language of a greater assembly, of 'debate,' but I trust that our discussions will continue to be conducted, as heretofore, with that good temper which makes even *debate* delightful, when the attainment of truth is the sole object. Truth will not bend one inch out of its right line, to accommodate false theory. He who tells us, that he "lost his patience when works were censured not as bad but as new," might be a very good poet, but in this respect at least he was no philosopher. One of our Vice-Presidents has presented me, within a few days, with a Report on the best mode of improving one of our great navigable rivers: this Report contains observations tending to level with the dust much that has been said by, I believe, all other Engineers, on the importance of tidal back-water. I know from experience that many theories which have, through their novelty or otherwise, appeared startling on the first view, have proved to be founded on truth, and have therefore superseded the old-fashioned notions. No class of men can be more devoted or bigoted to their opinions, than the Aristotelian philosophers were to their doctrine of syllogisms and *a priori* theories, which, though it had the authority of ages and names, was obliged to yield to the once-despised and even persecuted inductive philosophy of Bacon. Although, therefore, some Engineers may not coincide with the views expressed by our Vice-President, we shall do much good by examining impartially into the deductions he has drawn, at the same time carefully avoiding all personal considerations. A distinguished English Essayist after remarking that nothing denotes a great mind more than the abhorrence of envy and detraction, states, that the best poets of the same age have always lived on terms of the greatest friendship; and surely if this is the case with poets, who draw much upon imagination, Engineers, who have to deal with science and with facts, have less apology for excited feelings.

Without seeking in the recollections of a bygone generation for comparisons, we may congratulate ourselves that, although the number of Engineers has much increased, we are, I trust, without exception, *friends*; and I consider that our intimacy has been materially assisted by this Institution, where we have met, compared opinions, and rubbed off the sharp angles of professional jealousy or emulation, if any such existed.

Another valuable Member of the Council has, he conceives, discovered the true theory of the action of steam in the Cornish Single Pumping Engines, by which he accounts for their extraordinary economy. This theory, which is equally novel and ingenious, is now subjected to your examination and criticism, and I am sure that my friend Mr. Parkes would feel disappointed if his discovery were not to be submitted to that ordeal, in common with every similar subject of importance which is brought under the notice of the Institution.

While I congratulate the Institution on the increase of its Members, I ought at the same time to express my opinion, that from the number of young gentlemen who within the last ten years have studied for, or have entered, the profession, the supply is likely to be at the least equal to the demand; and to caution those who intend entering or are now studying for it, against confining themselves to the strictly professional part of the usual routine of education.

The Railways, both during the preliminary surveys and in their subsequent construction and management, in addition to other works of Engineering, have given employment to many. But the principal towns are already connected by Railways, or Engineers and Surveyors are now employed in projecting or executing lines where they are yet wanted. Is then the demand for professional gentlemen likely to *increase?* Is it not likely rather to *decrease?* Now certainly the number of Engineers or Students for Engineering s increasing. If we look at the number of students in the classes for Civil Engineering at the different Universities and Academies; the Universities of Edinburgh and of Durham; King's College, University College, and the College for Civil Engineers in London; we are led to ask, will this country find employment for all these? I freely confess that I doubt it. My object in what I have here said is, not to deter those who may already have resolved and have taken measures to follow the profession, but to advise them not to depend on this country alone, and so to direct their studies as to fit them for other countries also, where the field is not large enough to support men who are strictly and exclusively professional. For such, great countries only can find employment, and other great countries are educating their own engineers. To be fitted for going abroad to any part of the world, a man must be a tradesman as well as an engineer; he must furnish his *hands* as well as his *head*—and if he know more trades than one, so much the better; for he may have to direct in *all*, but *one* he ought to know thoroughly. Thus stored, all the world is open to him, and with the formation of new continents and colonies, and the improvement in the old ones, the engineer may insure independence. Not only in such countries, but at home also, his experience as a workman will prove his best friend and assistant in raising him to eminence, and make him feel that confidence in his own resources which has enabled so many engineers, whose name and fame stand high in the annals of the profession, to raise themselves from the millwright, stone-mason, and carpenter, to the highest grade. As a strong corroboration of the system which I recommend, you will observe the practical education given by each of these individuals to those of their family who are intended to succeed them. Let it not be supposed that I would undervalue the importance of science or of a scientific education, which is as essential to the Engineer as the knowledge of the principles of navigation is to the naval officer, but that I earnestly recommend *practice* also.

I hope to be excused this digression, but the great number of young gentlemen who, having been bred in Engineers' offices, apply to me for employment, which I cannot give them, or to be admitted as apprentices when I cannot in justice receive them, makes me feel very sensibly the importance of these remarks, and that it is almost a duty to give this publicity to my opinion.

To return to the Institution: I hope the attendance at the ordinary Meetings will be even better than that of last Session—that the Secretary's list which is regularly posted up, will have still a greater number of bright spots and a smaller number of black marks opposite the names of the Council, as well as of the Members, Graduates, and Associates generally. I do not name this as a complaint, for the attendance has hitherto gone on improving, that of the Council influencing the Members.

I have lately referred to the very great, and I fear, increasing, number of debts due to the Institution from Members and Associates, and still more from Graduates who were elected under a promise to send in an original communication or drawing, and I hope that the present Session will show a great reduction in the amount of these engagements. The fear of not producing something of sufficient value operates probably to overcome the desire which every gentleman, having made a promise, must feel in redeeming it. As an encouragement, let me refer such persons to the contributions by Graduates during the last Session; they will find that some of them required little inventive genius, but only the ability to record correctly what they have noticed on the public works in which they have been engaged, or which they have visited. To some of these, the Council have awarded premiums, and they esteem them valuable as recording details of works taken from measurements at the time of execution, thus forming an addition to our records, and making the Institution a deposit of "*works done*," which is one of its important uses; and I think no Engineer intrusted with public works would prevent Graduates having the opportunity of doing this for their own improvement, and for the benefit of the Institution.

The subjects for these papers, models, and drawings, are numerous,—I may almost say, innumerable. Of many of the great national manufactures of this country we have as yet no records in our possession, and until we possess them our stores will be imperfect. As an Encyclopædia gives a definition and general description of art, so should our Institution possess an original history, and drawings or models, as well as books, treating on every machine and manufacture connected with our profession.

Members of the Council during the last Session contributed liberally in books, and have set an example to the present Council. As a guide or specimen of the nature of the desired communications, the subjects for the Telford premiums have been varied and enlarged, but it is not to be understood that the subjects therein stated are to occupy exclusively the attention of Candidates, even for the Telford premiums. By thus enlarging the subjects and inviting papers, we may, I hope, look for an increased number of valuable communications, which it may press upon the Telford Fund to do justice to; I have therefore informed the Council that I have appropriated the interest

of One Thousand Pounds, 3 per cent. Government securities, or Thirty Pounds per annum, which I request the Institution to accept, as my Annual Donation, to be applied as may appear best suited for the objects to which I have referred, or for other purposes conducive to the benefit of the Institution.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

March 8.—Jos. Kay, Esq., V.P., in the Chair.

Messrs. W. A. Burn, and J. J. Cole were elected as Associates.

The resolution of the Council was read on the Essay sent in for the prizes offered by the Institute, and it was announced that the medal had been awarded to Mr. Edward Hall, (late of Birmingham), for his Essay on Iron Roofs.

Mr. George Godwin called the attention of the Institute to the investigations in progress concerning the origin of several fires supposed to have been caused by overheating the pipes of hot water apparatus.—A discussion took place on the effects likely to be produced by the temperatures to which hot water may be raised under pressure, and Mr. Godwin was requested to ascertain and report to the Institute such facts as might be developed in the course of the inquiry to which he had alluded.

A paper was read on the Architectural Antiquities of Wisby, in the island of Gothland, communicated by John White, Esq.

Wisby in the 10th and 11th centuries was one of the most important commercial cities in the North of Europe, and is is said to have contained eighteen churches, of which there are still extensive remains. These buildings, which display the pointed arch, claim an antiquity greater than is generally conceded to that and other characteristics of the Gothic style, especially the church of St. Lawrence, built in the year 1046, St. Drotten in 1086, St. Peter in the same year, and St. Nicolas in 1097. These pretensions to the high antiquity of the pointed arch Mr. White supported by numerous citations from Klingvall, Pontanus, Jonas Coldingenses, and other northern historians. In the discussion which ensued, it was suggested that the original foundation of these buildings might have been preserved in history, and that they might have been rebuilt at a later period without any record of the fact having survived, an argument now fully admitted in several cases, (that of the Cathedral at Coutances for example), in which dates have been assigned inconsistent with the character of the architecture. But although Mr. White's paper may have been not altogether conclusive on this point, it drew forth the warmest acknowledgments of the meeting, as a most valuable accession of new matter to the stores of the architectural antiquary.

March 22.—Edward Blore, Esq., V.P., in the Chair.

Mr. Frederick John Francis was elected an Associate.

A letter was read from Professor Willis, Honorary Fellow, accompanying the copy of a curious and probably unique drawing (in England) of the profile of a door at Stephen's Church, Bristol, from a MS. of the Itinerary of William of Worcester, in the Library of Corpus Christi College, Cambridge. This work has furnished many of the technical terms used by the architects of the middle ages, but the drawing, which has been overlooked until the present time, throws new light upon several of them, especially on the term "corse," which has hitherto been a crux to antiquaries, and is omitted in some of our best glossaries.—Mr. Poynter first indicated the application of this word to the pinnacles of St. George's Chapel at Windsor, in the contract for vaulting the choir of that building, and its occurrence in the drawing in question applied to the flanking pinnacles of the doorway, seems to fix its meaning. It is probable however that the square shaft of the pinnacle only is intended, and that perhaps with reference to a peculiar use.—"A corse with an arch buttant" is mentioned elsewhere by William of Worcester, and in both the cases referred to, the shaft of the pinnacle serves as an abutment—at St. George's to the arch buttant (or flying buttress), and at St. Stephen's to the lofty pediment over the arch.

A paper was read on the Electrotype by Mr. G. H. Bachhoffner, Professor of Natural Philosophy, Queen's College, Guernsey, and Lecturer at the Royal Polytechnic Institution, who accompanied his experiments by several suggestions as to the mode in which practical architecture might be benefitted by this invention.

Mr. George Godwin in pursuance of the proceedings of the last meeting, detailed the results of the investigation into the cause of the fires at Manchester, conducted by Messrs. Davies and Ryder, at the instance of the Manchester Assurance Company, and embodied in their printed "Report on Perkins's system of warming buildings by hot water."—Mr. C. J. Richardson combated the report, and was disposed to question the accuracy both of the facts and conclusions. Even if it were admitted that ignition had been caused by hot water pipes, they were, according to his statement, not those of Perkin's apparatus, but of imperfect and bungling imitations.

The Institute then adjourned over the Easter holidays, the next meeting being appointed for the 19th of April.

THE OXFORD ARCHITECTURAL SOCIETY.

Feb. 10.—The Rev. Dr. Buckland in the Chair.

The following new members were admitted:—The Earl of Dunraven, Adare Mawr; Rev. the Warden of All Souls' College; Rev. Thomas Symons, M.A. Ensham; Rev. Henry Richards, M.A. Horfield, near Bristol; Thomas Stock Butterworth, Esq., Westbury, near Bristol; Rev. George Dawson, Exeter College; Rev. R. Greenall, Brasennose College.

The following papers were read:—

1. On Stanton St. John's Church, near Oxford, by Mr. Simpson, of Oriel College, illustrated by numerous sketches. The chancel of this Church is an interesting specimen of the transition from the early English to the Decorated styles towards the end of the thirteenth century. The east window is very remarkable and almost unique, the tracery being carried in straight lines through the head with foliations and good mouldings. Some of the original stained glass is preserved in the side windows, and some painting on the wood-work in the body of the Church.

2. On Montivilliers Church, in Normandy, by the Rev. T. W. Weare, Christ Church. This Church affords a curious specimen of the change from the Norman to the Gothic style, which was very scientifically traced by Mr. Weare, illustrated by several sketches, and by comparison with other buildings, particularly with Christ Church Cathedral.

3. On the restoration now in progress in the Temple Church, London, communicated by Sir Alexander Croke, through the President of Trinity College. This restoration appears to be conducted in the best taste, and is entitled to the cordial approbation and admiration of all lovers of architecture, and is the first real restoration of a Church to its original state, with its painted roof, stained glass windows, and polished marble pillars.

4. On the recent discovery, by the Rev. C. F. Watkins, at Brixworth Church, of the foundations of a round end to the chancel, from which it has been assumed that this was a Roman Basilica; and it is proposed by Mr. Watkins to rebuild the chancel in its original form and on the old foundations. The Chairman made some observations on the published account, and showed that the conclusion that this was a Roman Basilica was somewhat hastily arrived at, and scarcely borne out by the facts, since the round east end or apse was the common form of building Churches down to the twelfth century; and the workmanship of this Church is of so very debased a character as to be much more likely the rude imitation of a later age than genuine Roman work; nor does there appear to have been any occasion for a tower to a Basilica. It was also objected that to rebuild the chancel on the old foundations would perhaps invalidate the evidence, now so valuable, of its original form which these circular foundations afford. And a hope was expressed that measures might be taken to preserve these foundations in such a manner as to be accessible to the student of Architecture.

The Secretary mentioned that a local Society has been established at Bristol, according to a suggestion in the rules of the Oxford Society; and it was agreed that a copy of each of this Society's publications should be presented to the Bristol Society.

REVIEWS.

The Railways of England. By Francis Whishaw.

(Second Notice.)

Agreeably to the promise, we continue our extracts from Mr. Whishaw's work, the first which comes before us on this occasion relates to the Birmingham and Gloucester Railway.

The Ballasting on the London and Birmingham is thus described.

The ballasting is of the width of 28 feet, and 22 inches in thickness. There are no less than seven different descriptions of ballasting; viz. burnt clay, burnt marl, gravel, sandstone, cinders, rock marl, and broken stone. The burnt clay and burnt marl cost from 1*s.* 2*d.* to 2*s.* 6*d.* per cubic yard; the gravel and sandstone from 6*d.* to 1*s.* 6*d.*; the cinders from 2*s.* 6*d* to 3*s.*; and the rock marl and broken stone (lias and oolite) from 9*d.* to 5*s.* 6*d.* per cubic yard. So many descriptions of ballasting, and so many different prices, cannot be heard of in the history of any other railway.

With regard to the Durham and Sunderland railway we find

Some of the embankments on this railway are formed chiefly of small coal, which is, perhaps, the best material that can possibly be used for this purpose; the cost is stated to have been 9*d.* per cubic yard: except, however, in the largest coal distincts, its use is entirely precluded by the cost of carriage.

Of the inclines on the same line a longer account is given.

To work this railway there are eight fixed engines: the first, or Sunderland engine, being of 70 horse power; the second, or Seaton Bank-top, 42 horse; the third, or Merton, 70 horse; the fourth, or Appleton, 83 horse; the fifth, or Hetton, 42 horse; the sixth, or Moorsley, 52 horse; the seventh, or Piddington, 85 horse; and the eighth, or Sherburn, also of 85 horse

power. Thus the united power is equal to that of 529 horses. The men employed in this department are nine engine-men, at 24s. a week each; twelve stokers, at 18s.; and nine drummers, at 14s. each per week.

The first plane, ascending from Sunderland to Ryhope, is worked by three ropes; two being each 2450 fathoms in length, of 5¾ inches circumference, and weighing together 43,200 lb.; and the third 4¾ inches circumference, and weighing 13,216 lb., and also 2450 fathoms long. The Seaton plane is worked by one 7¼ inch rope, 2,325 fathoms in length, and weighing 32,588lb.; the rope is drawn out by the wagons descending by gravity. The Merton incline has two ropes; the one a 5 inch, 1250 fathoms in length, and weighing 8333 lb.; the other of 6¾ inches circumference, 575 fathoms in length, and weighing 6986 lb. The fourth plane is worked by one rope for the ascending, and by gravity for the descending wagons; this rope is of 6¾ inches circumference, 740 fathoms in length, and weighing 8990 lb. The fifth incline is also worked by one rope, which is of 4½ inches circumference, 1425 fathoms in length, and weighs 7694 lb. The sixth plane has two ropes; the one being of the same length and weight as the last; and the other being 700 fathoms in length, 5½ inches in circumference, and weighing 5124 lb. The seventh and eighth planes are each worked by a single rope, the length of each of which is 2450 fathoms; the size of the seventh being 5¾ inches, and the weight 21,600 lb.; and of the eighth, 4 inches, and the weight 15,120 lb. The whole weight of ropes, therefore, is 170,545 lb., or 76·13 tons. Mr. Blenkinsopp, the engineer of this railway, estimates the cost of these ropes at 40*l*. per ton, and their average duration about nine months. In this case, the annual cost for ropes on this line would be 2283·90*l*., or 172·63*l*. per mile. At level road-crossings, the ropes run in channels properly constructed for the purpose. The rope-sheeves are of cast iron, weighing 28 lb. each, 12 inches in diameter and 7 inches wide; some of them being fixed in cast-iron standards, and others in wooden boxes, at intervals of 18 and 24 feet respectively. In curved portions of the line they are inclined to the horizon. At night the way is lighted by large fire-lamps, three at each bank-head.

The description of the inclines on the Dundee and Newtyle railway, will very appropriately follow.

The planes worked by fixed engines are the Law, the Balbeuchly, and the Hatton inclines.

The Law incline, which is 1060 yards long, the ratio of inclination being 1 in 10, is laid with three rails at top, four in the middle, and two at the bottom. It is worked by a forty-horse high-pressure engine, having a cylinder of 21½ inches diameter; stroke 5 feet; rope-roll, 12 feet in diameter; the pinion on fly-wheel shaft having 32 cogs, and the spur-wheel on rope-roll shaft 97 cogs; the usual working pressure is 40 lb. on the square inch. The ordinary loads are from twenty to twenty-four tons, including a ballast-wagon of four tons, which always accompanies the train in its ascent, and is furnished with a break and clutches for the purpose of stopping the train in case of the rope breaking. The time occupied in the ascent is about six minutes. The counterbalance is of from ten to twelve tons weight. The cost of this engine is stated to have been 2750*l*. The rope is of 7¼ inches circumference, and weighs 8960 lb. The Balbeuchly incline, which has a single way only, is about 1700 yards in length, ascends at the rate of 1 in 25, and is worked by a 20 horse condensing engine; cylinder 26¾ inches, stroke 4 ft. 6 in., usual working pressure of steam 4½ lb., the pinion on fly-wheel shaft has 48 cogs; rope-roll 12 feet diameter; and the spur-wheel on rope-roll 97 cogs. The usual load is about 16 tons; the time occupied in the ascent being six minutes. This engine cost 1600*l*. The rope is of 5½ inches circumference, 900 fathoms in length, and weighs 7056 lb. The Hatton incline, which is also laid with a single way, descends to Newtyle, at the rate of 1 in 13, for a length of 1000 yards. It is worked by an engine similar to that for the Balbeuchly incline. The pinion, however, has only 31 cogs, and the spur-wheel 94 cogs. All the above inclines are straight; the sheeves are fixed at intervals of six yards. The consumption of fuel for the three engines is about 85 tons per month; the coals used are from Preston Grange, east of Edinburgh, and cost 10s. a ton delivered on the line.

The plan on the Edinburgh and Dalkeith railway, for stopping the trains in case of the rope breaking is ingenious.

Mr. Rankine calls it a self-acting stopper. It consists of two plates of iron, each having a double claw, the points of which are 15 inches asunder. These plates are each 13¼ inches in extreme length, 9 inches along the middle line of each, and 6 inches wide in the middle, increasing to 15 inches at the points of the double claw. The plates are ¾ of an inch thick, and 5¼ inches apart, secured together with 1⅜ inches bolts. At the narrow end is a roller, 2 inches in diameter; in the middle is a 2 inch axle, to which an arm or lever is attached, this lever being connected at its upper end with the last wagon of the train. By means of the roller the stopper runs on one of the rails; and the lever, by which it is connected with the wagon, keeps the stopper at uniform distance from the train while in motion; but in case of the rope breaking, the train immediately runs back, raises the arm, and thus throws the stopper over, which causes the train to run off the rails.

On the subject of the Leeds and Selby earthworks, Mr. Whishaw approves of the mode of constructing the embankments.

Some of the embankments are of considerable height; and instead of being carried up with regular slopes, have their sides faced to a curved batter, the chord-line of which forms an angle with the base of about 67½°. Where stone is plentiful, this is decidedly an economical mode of constructing embankments; for not only is the quantity of earthwork very much reduced, but there is also a considerable saving effected in the area of land required. The same observation will apply to the lower portions both of cuttings and embankments; for by carrying up retaining walls for about 1½ to 2 yards in height, the quantity of excavation is much reduced, and also the area of land. Where stone-fence walls are placed on the top of the embankments, the whole width is 30 feet, and the clear width 27 feet.

We shall follow this by a description of the Manchester and Birmingham drains executed under the direction of Mr. Buck.

Besides the open field drains, circular perforated earthen drains are used to great extent in the cuttings. They are each 2 ft. 5 in. long, 14 inches in extreme diameter, and 12½ inches in the clear. They are formed as iron water-pipes, with spigot and faucet; the clear diameter of the faucet, or larger end, being 14¾ inches, and the whole depth of the neck 4 inches.

The following observation is made by our author as to the use of bricks, while speaking of the Midland Counties railway.

The bridges almost throughout this line are built of red brick, the copings and strings being formed of hard-burnt brick earth, of the particular form required, as on the South-Eastern Railway. This plan might be advantageously carried out in many other districts where brick-earth is abundant.

Cowran Hill Cutting on the Newcastle and Carlisle railway hereafter described, was originally intended to have been a tunnel.

The strata intersected consist chiefly of clay, with intermixed veins of sand. The length is about one mile, the average depth 43 feet, and the greatest depth, 110 feet. The width of this cutting at level of rails is 26 feet. The sides are carried up with slopes of 1½ to 1, and below the slopes is a retaining wall on either side, built of stone, 14 feet in height, 2 feet wide at top, and having a sufficient batter from the railway. On the top of each retaining wall is an open drain, which receives the water from the slope; and by means of vertical drains, which are connected with the main drains running under, and having the same inclination as the railway, the surface-water is entirely emptied into How Beck.

On the same line we have some interesting details as to the bridges.

There are several bridges of wood spanning the rivers. The chief one is that at Scotswood Road, being constructed on the skew principle. It is 30 feet on the square, and 50 feet on the skew span, and 30 feet high above the road. It is built of iron and stone, having five girders, weighing together 70 tons. The parapets are of rubble walling, coped with masonry. The whole presents a useful and economical piece of workmanship.

On the branch to Redheugh there is a bridge of singular construction, which carries a coal-way over the line. This bridge, which is of wood, and 3 ft. 4 in. wide, represents, as it were, the skeleton of lock-gates, consisting of four trussed portions, each hung folding, the meeting parts being furnished with small wheels, which run on iron segments when the gates are opened for the purpose of allowing the locomotives to pass.

Buchanan's Practical Essays on Mill Work and other Machinery. Re-edited by GEORGE RENNIE, C.E., F.R.S., &c. Part I., 30 Plates and Text. London: Weale, 1841.

Robert Buchanan's Essays on Millwork are well known to every practical engineer, and still better as having been subsequently revised by Tredgold. To bring the progress of the art up to the present day, and to describe the modern improvements was a task yet to be attempted. This has happily devolved upon George Rennie, and it is almost superfluous for us to say that no better man could have been intrusted with them, to one who has cultivated with equal success both the theory and the practice, who is himself the author and inventor of so many of the innovations, which he will be called upon to describe.—Having contributed so much to enlarge the world of science, it was the least that we could expect of him, that he should come forward to do justice to his own works and those of his predecessors, the more particularly as he has in his own factory a museum from which to draw ample means of illustration.

The present Part is principally confined to the elementary matter, but the plates in it which refer to the forthcoming one give promise of most valuable matter. Among them are Bramah's Slide Lathe, his Lathe for turning Spheres, the Great Boring Lathe, the Wallside Drilling Machine, the Double Pillar Drill, the Key Grooving or Slotting Machine, Self-acting Nut-cutting Machine, machine for cutting the Teeth of Wheels, another for cutting the Teeth of Wood on Wheel Models, the Vertical Boring Machine for Cylinders, Planing Machine for Iron, Nasmyth's Planing Machine, a Punching Machine, Heck's Mandrel for expanding rings, &c.

Of Mr. Weale's exertions in this work we shall only say that both to civil and practical engineering he seems determined to afford equal benefit, those who remember Tredgold on the Steam Engine, will be prepared for a work got up with equal care.

The Laws of Trade. By CHARLES ELLET, C.E. Published in America. London: Wiley and Putman.

Some time ago we made long extracts from this author, explaining his system of charging tolls for goods; the work is now published in a collected form, and comes before us for recommendation to our readers. Mr. Ellet has exhibited great industry and acuteness in the investigation of a branch, as he says, but too little cultivated by engineers. The engineer who is best versed in the technicalities of his profession, will still be unadapted to the application of them, and the due discharge of his duties, unless he should have studied something else. The engineer is no bricklayer to put down a railway or canal just where he may be told, but he is an adviser who has equally to consult his own reputation in the stability of his works, and in the happy position of them for traffic. Mr. Ellet has conferred a boon on his profession, in calling attention to the laws which regulate traffic, and the revenue to be derived from it, and we hope that he will be imitated by his brethren here.

Tables of the Logarithms of Numbers, &c. By EDWARD RIDDLE, F.R.A.S., Master of the Mathematical School, Greenwich Hospital. London: Baldwin, 1841.

This is a cheap reprint of logarithmic tables from Mr. Riddle's work on Navigation, and as such we recommend it to our readers.

Practical Rules for the Management of a Locomotive Engine. By CHARLES HUTTON GREGORY, C.E. London: Weale, 1841.

Mr. Gregory is known as the Resident Engineer on the London and Croydon Railway, and some months ago he sent to the Institution of Civil Engineers a paper on the management of the locomotive engine, which since, by their permission, has been republished. It is made up in the form of a small manual, so as to go in the waistcoat pocket of an engine driver, and is printed in a good legible type. We equally applaud the design of the work and its execution.

An Experimental Inquiry into the Strength and other Properties of Anthracite Cast Iron. By WILLIAM FAIRBAIRN.

This pamphlet contains the continuation of Mr. Fairbairn's experiments on iron, and we refer our readers to it as containing some of the most valuable information as to anthracite, and the iron made from it.

ENGINEERING WORKS.

THE ARTESIAN BORING AT PARIS.

M. Arago who both as a member of the municipality of Paris, and as a "savant," has been one of the most active promoters of the Artesian Well of Grenelle, reported to the Academie des Sciences on the 1st ultimo, several details respecting the successful results obtained on the Friday preceding, which we think will be read with interest. Several Artesian wells on the right bank on the Seine at Epinay, Saint Denis and Saint Ouen, had given rise to the expectation of a supply to the city of Paris by the same means, which up to that time had been found attended with but a slight expense. The Municipal Council partaking in these hopes gave orders for the sinking of borings in the square of the Madeleine, at Gros Caillou, and at the Jardin des Plantes. The former was however abandoned nearly as soon as commenced, for reasons of a private nature, and the other did not succeed; nevertheless at the Jardin des Plantes the water had risen to within a few feet of the surface of the ground, essentially constituting an Artesian spring, although it held out no advantages beyond those of a common well, as in order to raise the water to the requisite height it was still necessary to have recourse to a pump. The fact of its not attaining a higher level at first appeared remarkable, but it was soon discovered that the sheet of water which fed the fountains of Saint Ouen and Saint Denis *cropped out* or came to the light on the banks of the Seine between Chaillot and Saint Cloud.—It was thus shown that this subterranean reservoir was subjected to a comparatively small pressure, and could give no encouragement to the establishment of Artesian foundations on the left bank of the Seine.

Notwithstanding this, the municipality entertaining views in accordance with those of a majority of geologists, did not give up the prospect of furnishing Paris with a supply of subterranean water. Already aware that several Artesian borings had been attended with immense success both at Tours and at Elbœuf, these being sunk into a stratum separated by the entire chalk formation from that of Saint Ouen, the council resolved in the year 1832 to make efforts to attain this second water-bearing stratum, and M. Mulot who had already undertaken several of the Artesian wells in the neighbourhood of Paris, entered into a contract to execute the Puits de Grenelle, which was commenced in the beginning of 1833.

Very nearly from the commencement of the undertaking unfavourable prospects became manifest. After perforating the tertiary sands, which at Grenelle are 41½ metres (136 feet) thick, and nearly as soon as the rods had reached the chalk, part of the rods detached themselves and fell to the bottom of the bore-pipe with great force. Considerable difficulties had consequently to be overcome, but these were soon surmounted, and the only result of this accident was a slight delay. In May 1837, when the boring had attained a depth of 380 metres (1246 feet 8 inches), a second and far more serious accident occurred—the chisel with which the ground was perforated, and a length of 80 metres (262 feet) of rods, again fell to the bottom. These weighed together (100 quintaux) five tons, a mass which it was absolutely necessary to raise again to the surface. It is already a serious matter to lift so considerable a weight when all the usual mechanical means are allowed to be brought into play, it may therefore readily be conceived that acting at a height above the object equal to thrice that of the towers of Notre Dame, and in a space having only a limit of a few inches, the obstacles are incalculable, and success almost a miracle. However, M. Mulot attained his object, he succeeded in tapping a screw on the head of the rods, and thus connecting another length to them, after 15 months of vain efforts, the chisel was at length brought up in August 1838, and the works proceeded with—they were, however, destined to be again interrupted before their conclusion.

The third accident occurred on the 8th April, 1840, the boring had then attained the rock chalk. Although the instruments were used with considerable dexterity, they made but slow progress. Suddenly however the chisel, the perforating end of which was extremely sharp, having been raised with great force, sunk at one stroke 26 metres (85 feet 3 inches) in the chalk. It then stuck so fast that no efforts could succeed in raising it, and had much force been resorted to, a fracture would have been the consequence, which would have led to a far more serious accident.—M. Mulot, whose inventive powers set a resolute face against every new difficulty, preferred setting the boring apparatus free by enlarging the hole on all sides, in which he was completely successful. The fourth accident was of less importance than the previous two, the chisel alone became detached, and its fall presented a new obstacle. M. Mulot at once saw that the remedy resorted to in the case which had occurred in May 1837 was no longer applicable, and the small size of the instrument led him to hope that he could pass on one side of the chisel. A cavity was formed in the side of the boring, and the instrument was forced therein. The works were then immediately recommenced, and no other detention occurred.

At last on Friday, 26th February, after 8½ years exertion, the rods suddenly sunk several metres,—the workmen perceived that all resistance had ceased, and after a few hours interval a majestic column of water 1691 feet in height (1847 English feet), the weight of which is equal to 53 atmospheres, rose from the bosom of the earth. Our globe having a temperature which increases as we descend, the water that flows from its interior assumes a warmth proportionate to the depth whence it rises. That of the Puits de Grenelle is at present 27°. 6 Cent. (81°.7 Fahr.) and it will increase as soon as the sides of the boring shall have attained the temperature of the ascending water.

The difficulties which have been described are not the only ones which this gigantic undertaking has had to overcome. The sides of the bore-hole are apt to crumble away, in which event the fragments falling in would fill up the hole and obstruct the working of the boring tackle. The strata which are perforated are also full of fissures, which might offer a vent to the ascending waters and cause them to be lost. These circumstances in connection with others which we cannot here enumerate, render it necessary to line the Artesian wells with a metal or wooden tube. This operation, which is not an easy one, even when a well is but some hundred yards in depth, increases in difficulty the deeper the works are carried. To effect it a tube of a certain diameter is first introduced, then a second one fitting into it succeeds, a third descends through the second, and so on;—these tubes exactly resembling those of a telescope, it is readily conceived that as they constantly diminish in diameter, unless they have been very nicely calculated, the aperture at last becomes too small for the free working of the boring rods. It is then necessary to lift all the tubes out and replace them by others of a larger diameter. At Grenelle it became five times necessary to remove the whole lining of the boring, and also each time to enlarge the bore-hole to allow of the introduction of larger tubes.—Let our readers then figure to themselves a cast iron column eight times as high as the towers of Notre Dame, which must be lifted out and replaced by another—they will then form a just conception of the patience, care and intelligence necessary.

The supply of water produced by the Puits de Grenelle is equal to upwards

of four millions litres (880,387 gallons) per 24 hours, being nearly a gallon for each individual in Paris.—The waterworks of Gros Caillou Chaillot and the engine near the bridge of Notre Dame supply at the most, double this quantity; the well at Grenelle consequently, notwithstanding its first cost of 250,000 francs (£10,000), affords a cheap supply of water, more particularly if we bear in mind that this kind of fountain requires no repair.

Some persons are already raising doubts as to the continuity of the supply, resting their argument on the fact of some of the wells at Tours yielding less water at present than when first opened. They may, however, lay aside all uneasiness—if some of the wells at Tours have undergone a diminution, a greater number have increased in abundance, their supply having augmented by nearly one-third—and this discrepancy as it appears at first sight, is easily accounted for, by those who enter into all the facts of the case, being found to depend upon the more or less perfect lining of the borings. In the Province of Artois where Artesian wells which have existed upwards of 300 years are found, no diminution of the quantity of water produced has ever been observed—which by the way is quite natural, the sheet of water which supplies these having an almost unlimited extent—stretching as it does over a space of several hundred square leagues (1 square league = 5 square miles), the outlets to which (being these bore-holes) are almost unappreciable. This also shows us that greater numbers of wells may be sunk into the same stratum without affecting one another in the least. The outlay is however too great ever to lead us to expect much competition, and the perforation of the strata under Paris leaves us easy as to the future.

From an analysis made by M. Pelouze the water of the Puits de Grenelle is of a very good quality, and far purer than that of the Seine or of Arcueil, 100 litres only gave 14 grammes of extraneous matter (100 cubical inches gave 3½ grains,) whilst a similar quantity of water from Arcueil, or from the Seine, yielded 17 grammes in suspension, and 46 in chemical combination, (100 cubical inches yielded 4·3 grs. troy mechanically suspended, and 11·6 grs. troy of chemical impurities).

An important question, and one the solution of which will not be completely attained for a few months, is the height to which the water will rise—referring to the levels where this water first percolates into the strata, we may hope that it will reach higher than the "Plateau" of the Pantheon—if this expectation be realized, all the various districts of Paris can be attained, and the improvements which the municipal council of Paris have long contemplated of supplying every habitation will be effected in a simple and economical manner, as it will only be necessary to make two or three other wells like that of Grenelle.

We cannot however be certain of the ascentional power of the water until the boring rods are withdrawn from the well, and the lining completed—some time is therefore still necessary before we know all the advantages which the perseverance of the municipality will have procured—a courageous perseverance which we cannot sufficiently praise, and which has had to encounter the lively attacks of many persons who fancied it impossible, that flowing water could ever be obtained by the means brought into play. The council however placed the greatest confidence in M. M. Eymery and Marie, the engineers charged by the "Ponts and Chaussées," with the superintendance of the supply of water to Paris, and who had first originated the proposal of an Artesian fountain.—It was also supported by the opinions of MM. Elie de Beaumont and Arago, who never for a moment doubted of the final success of the undertaking, their confidence being based on analogy, and on a complete acquaintance with the geological conformation of the Paris basin.

We will endeavour to explain the reasons upon which they grounded their opinion:—

Paris occupies the centre of a basin, bounded on the west by the hills of Brittany and of La Vendée, on the south by the range which traverses the centre of France, and on the east by the Chain of the Vosges; this basin is filled up by successive layers, moulded as it were upon it, and fitting one into the other like those sets of cups we sometimes see inclosed in each other in order to occupy less room.

It will be clearly seen that each of these layers exposes its edges or outcrop to the day at greater or less distances from the centre. Those filling up the basin of Paris form three successive kinds of strata. The first or upper one called the tertiary formation consists of gravels and sands as found at Fontainebleau, of the gypsum which yields the plaster of Montmartre and St. Chaumond (plaster of Paris), of the limestone of Vaugirard and Montrouge, which supplies building materials for Paris, and lastly, of the plastic clay employed in all the potteries of the capital.—This last layer contains the sheet of water of St. Denis and St. Ouen. The second formation which immediately follows is the chalk which may be seen on the banks of the Seine from near Paris to Havre.

The third consists of various limestones connected with the Jura mountains, and consequently called the Jura formation (in England the oolitic).—The second water bearing stratum that of Tours and Elbœuf occupies the lower part of the chalk: it consists of a thick bed of sand inclosed in two very considerable layers of clay. The sand forms a kind of sponge which imbibes the water, and the beds of clay are as it were the sides of a pipe confining it, and whence it escapes whenever a perforation occurs. This stratum then, if it be continuous under the basin of Paris, if it exactly represent the cups we have described, must crop out at a certain distance from Paris, and form a kind of circle round it more or less regular in shape. This is actually the case. M. Elie de Beaumont has presented to the Academy a collection of samples of the sands belonging to this bed, and obtained at Cap la Hève near Havre, in the neighbourhood of la Fleche and Bonne Etable in the Sarthe, from Chateau la Valière in the Department of Indre et Loire, and from Allichamps near Vassy in the Haute Marne. All these are identical, and resemble the sand brought up with the water of the Puits de Grenelle. It is then evident to every one, as it long has been to geologists, that this sand forms a continuous basis to the Paris basin. Similar in shape to the bottom of a boat its sides rise to the day, whilst the centre is at a great depth from the surface. The waters falling on its edges or outcrop filter in and have formed a subterranean sea, occupying the entire width of the basin. Geology is thus established by the Puits de Grenelle as a positive science in the eyes of the whole world, and the conformation of the Paris basin made known with certainty.—*Le Constitutionnel, March* 4.

THE MAPLIN LIGHTHOUSE.

In the second volume of the Journal, page 38, we gave a description of the foundations of a Lighthouse to be constructed on a novel principal, by direction of the Trinity Board, under the superintendance of Messrs. Walker and Burges, the eminent engineers; the spot selected was the Southerly point of the Maplin Sands, which form the northern extremity of the Swin Channel, at the entrance of the river Thames. The foundations, as we before described, consisted of nine of Mitchell's patent mooring screws, with shafts of wrought iron 5 inches in diameter and 26 feet long, one was fixed in the sands in the centre, and the remaining 8 at the angles of an octagon 40 feet diameter, the screws were turned into the sand to the depth of 21 ft. 6 in., the top being then within 4 feet of the low water mark of a spring tide.

After the screws were fixed in August 1838, it was determined to leave them for a few months; from that period to June 1839, every change in the surface of the sand was observed, and notwithstanding that in the early part of 1839, there were several storms of more than ordinary violence, yet the screw piles stood firmly, and the sand at no time was lowered more than 3 feet. As a precautionary measure the engineers had constructed an open platform or raft of timber in two thicknesses, crossing each other at right angles, and bolted together at their intersections, which covered the whole site within the piles, and also extended some distance beyond them; round the exterior was raised a curb 18 inches high; over the platform was laid brushwood, and then about 200 tons of rough stone which sunk the raft on to the sand and prevented it being displaced, between the spaces of the platform and the brushwood the sand was allowed to work its way up, which soon filled the interstices of the stone. Very shortly after the whole of the platform and stone was embedded below the surface of the sand, which gave considerable support sideways to the screw piles, and formed a solid body for the water to wash upon. Nothing farther was done on the spot till the framing for the construction of the lighthouse was ready to be fixed in August 1840, when upon a careful examination it was found that the raft had completely settled down, and the piles as firm as the first day they were screwed in—it was then determined to proceed with the erection of the superstructure, which we shall now proceed to describe. The lower part consists of eight cast iron pillars 18 feet long, 11 inches diameter externally, and 9 internally, they are fixed at the angles of the octagon, and in the centre there is a similar pillar 22 feet long; the lower part of the pillars forms a socket, and is fitted over the top of the shafts of the screw piles to the extent of 4 feet, to which they are attached by adjusting screws of wrought iron; the upper part of the pillars also forms a socket 12 inches clear diameter, and 4 feet deep, into which are fixed the principal posts of the timber framing—these pillars are fixed inclining towards the centre. The pillars are tied together at top and bottom with wrought iron horizontal bars 2½ inches diameter, fitted with collars and screw bolts; similar bars are fixed on the same level in a raking position to the centre pillar, by the aid of which the whole are firmly tied and braced together—the top of the pillars stands about 4 feet above high water mark of a spring tide. The timber framing was commenced by first fixing the centre post 21 feet long and 14 inches square, and subsequently those of the angles, 30 feet long, 12 inches square at the base, and 10 inches square at the top; they are tied together at the bottom by double horizontal tie beams, 12 by 5, and 27 feet long, and at the top 10 by 4, and 21 feet long; the ends are secured to the angle posts by wrought iron nut and screw bolts and iron knees. There are also raking braces from the angle posts to the centre 10½ by 9, and 15 feet long; upon the tie beams are laid the flooring joists 9 by 3, the principal posts of the carcase framing are 6 by 4.

The interior accommodation consists of a living room 22 feet long, and a store-room in the upper part, and store-rooms for coals and water in the lower part. Thus far the erection was completed in October 1840, within a period of three months.

Above the living-room is fixed the lantern with a gallery all round—it is a polygon of 16 sides, 12 feet diameter internally, and 16 feet high from the floor to the roof; the principal part of the framing is of cast iron—the roof, the interior lining and floor are covered with copper. In the centre, raised upon a pedestal, is the beautiful apparatus of a second order of Dioptric light, made and fitted up, together with the iron work of the lantern, by Messrs. Wilkins and Son, of Long Acre. The height of the light above the mean level of the sea is 45 feet, and may be clearly seen from the deck of a vessel, in fine weather, upwards of 10 miles off in all directions. The light was first exhibited on the evening of the 10th of February last.

PLYMOUTH BREAKWATER LIGHTHOUSE.

A lighthouse is in course of erection upon the western extremity of the Breakwater, the first stone of which was laid by Admiral Warren, on the 22nd of February last, it was designed by Messrs. Walker and Burges, the engineers of the Trinity Board, in July last, and submitted to the Admiralty. Shortly after, their Lordships gave directions for its immediate construction. It is to be erected upon an inverted arch, the foundation of which is laid about 1 foot 6 inches below the level of low water spring tides, its centre at top is at the distance of 37 feet 6 inches from the western end or head of the Breakwater, and at the level of low water 195 feet. The diameter of the head of the Breakwater at the level of low water is 390 feet, and at the level of the top of the Breakwater 75 feet. The lighthouse is to be of granite 14 feet clear diameter, the centre of the light will be 55 feet from the top of the Breakwater. The interior will be divided into floors, forming a store room, a dwelling-room, a bed-room, and a watch-room. The lantern 12 feet wide and 7 feet 6 inches high, is to show a Dioptric fixed light of the second order, with mirrors; the south half to show a red light, to distinguish it from the coast lights, and the north side towards the Sound, is to be white. The stones of the lower courses are to be secured with dowels of slate, independent of a vertical and horizontal dovetail, the dowels are 18 inches long and 6 inches square at the centre, and sunk 8 inches into the lower course of stone, both ends are dovetailed and secured in their places by plugs in the upper, and by wedges in the lower stone. It is expected that the lighthouse will be completed by the end of 1842.

MERSEY AND IRWELL NAVIGATION.

We present in the accompanying reports of Mr. Palmer and Mr. Bateman the groundwork of a long discussion,* which has taken place at the Royal Victoria Gallery, Manchester. In this discussion which lasted for several evenings, Mr. Hawkshaw, Mr. G. W. Buck, Mr. Joseph Radford, Mr. W. Fairbairn, Mr. T. Fairbairn, Mr. Bateman, Mr. Thomas Hopkins, and other engineers took part. The proceedings are of particular interest on account of the important questions concerned in them, and of the public being thus brought to take a part in a professional subject. Of a debate of such length it would be impossible to give even an abstract, but we may mention some of the opinions put forward. Mr. Palmer is in favour of contracting the upper part of the river estuary, and forming the river as a funnel; Mr. Bateman is in favour of contracting the upper part, but opposed to interfering with the estuary; Captain Denham, opposed to contracting the estuary; Mr. W. Fairbairn, on Mr. Bateman's side; Mr. Buck, in favour of contracting the upper part, thinks the estuary might be partially contracted; Mr. Hawkshaw, of opinion that the upper part could not be improved without the neck of the estuary below Liverpool being contracted; Mr. Radford, Mr. T. Fairbairn, and Mr. Hopkins support Mr. Palmer. Thus in favour of improving the upper part of the river, the numbers are—

For, 7 .... Against, 1

With regard to the bay at Runcorn Gap,

For Mr. Palmer, 4; Mr. Bateman, 2; against, 2.

With regard to contracting the Mersey,

For, 4...... Partially, 1...... Against, 4.

Extracts from a "*Report on the Improvement of the Rivers Mersey and Irwell between Liverpool and Manchester, describing the means of adapting them for the navigation of Sea-going Vessels. By Henry R. Palmer, F. R. S., Vice-Pres. Inst. C. E.*"

At the time when inland navigation by means of artificial canals met with such extraordinary encouragement, the prevailing opinion was opposed to the use of rivers, chiefly on account of their currents, especially during rainy seasons. Probably this impression may have derived some of its strength, from the well-known bold expression attributed to the late Mr. Brindley, under whose superintendence the Bridgewater Canal was constructed. The advantages which that celebrated work exhibited over the natural line of navigation, *at the time* the former was constructed, were no doubt obvious, and many other instances might be cited, which would equally point out the superiority of an entirely artificial canal, over an *imperfect* or *ill-regulated* line of river navigation.

The actual distance, in a straight line, between the quay at Manchester, and the Company's Dock at Liverpool, is about thirty-three miles; while the length of the channel, in its natural course, between the same points, is forty-eight miles; the circuities amounting to no less than fifteen miles. Those circuities have, however, been reduced seven miles, leaving the present length of the line of navigation forty-one miles.

The width of the river at Manchester is 108 feet, at Warrington 140 feet, at Fidler's Ferry 170 feet, and at Cuerdly Point 650 feet.

From thence it rapidly widens to 3,500 feet. It is abruptly reduced to 1,200 feet at Runcorn Gap, and, within a short distance, is again widened to 4,200 feet.

The widths continue to vary considerably towards the river's mouth, extending in one part to two and a half miles, and again diminishing to 3,300 feet at Liverpool.

The level of the highest tide, uninfluenced by a strong wind, intersects the bed of the river at Woolston, being a distance by the course of the channel of about $25\frac{3}{4}$ miles above Liverpool, and the bed of the river at Manchester is 49 feet above the level referred to. The first weir in the ascending direction is at Warrington, and the distance from thence to Manchester is divided into 10 pools.

The navigation of the river between Liverpool and the lock at Warrington is dependant upon the tidal water, and the whole of the remaining distance upon that derived from the uplands.

At Liverpool the spring tides rise	33 feet
At Runcorn	$16\frac{1}{2}$,,
At Warrington....................................	8 ,,

The lowest of the neap tides at Liverpool rise $23\frac{1}{2}$ feet, and if the wind be strong in the adverse direction they do not extend to Runcorn. The depth of water at Liverpool with a high spring tide is 89 feet, but the bed of the river is rapidly elevated, and the depth during the same tide is diminished to 33 feet in a distance of $9\frac{1}{2}$ miles.

A 33 feet tide at Liverpool occasions a $16\frac{1}{2}$ feet tide at Runcorn; thus showing the bed of the river at Runcorn to be about $16\frac{1}{2}$ feet above the level of low water mark at sea, assuming the line of high water mark to be level between the two places. This, however, is not strictly the fact, and will be hereafter the subject of explanation.

The river is subject to considerable land floods, which descend with great impetuosity, and overflow the banks, laying under water extensive areas of marshes. A land flood implies an accumulation of the water of drainage derived from a more than ordinary quantity of rain. The river channel being proportioned only to an average quantity, the surface of the stream is necessarily raised. But the accumulations that are so injurious, and which are complained of, are not to be attributed to any natural deficiency in the capacity of the channel, but to the permanent barriers or weirs that have been erected, which diminish the water space nearly three fourths, without any compensation having been provided.

The evil consequences of such circumstances are of far greater magnitude than has been supposed. It is well known that the water in its descent over the lands, washes down such loose soil as it is capable of removing; the same being conducted into the channel of the river, it is carried out to sea, if the moving power continue to be sufficient throughout the whole distance. The natural slope of the Mersey above the tideway is such as would occasion a considerable velocity of the water, but by dividing it into a series of pools, the velocity is, as it were, concentrated at the weirs, and the motion between them is much inferior to that which is required for removing the soil brought down by the rains. The cleansing of the channel is therefore exclusively dependant upon extraordinary quantities of rain from whence an increased velocity is obtained.

But if the weirs were altogether removed, it is obvious the river above the tideway would cease to be navigable; weirs of some kind are indispensable where the slope of a river is great, but it is equally clear, that they should be so constructed as to prevent the least hindrance to the motion of the floods.

Seeing that the fixed weirs contribute so largely and injuriously to impede the motion of the water, and therefore to elevate its height during floods, we find that a large proportion of it is made to pass over surfaces which are in no way benefitted, but which are damaged by it; while its use as a scouring power is altogether lost. While these effects cannot, perhaps, be entirely prevented, they may be greatly diminished, by so constructing the weirs that the impediment they cause shall have relation to the quantity of water in the river. If the weirs were properly made self-adjustable, according to circumstances, the bed of the river would be acted upon during longer periods, and therefore more effectually cleansed.

From the parallelism of the upper division, its bed is comparatively regular. The lower division is, however, of a contrary character; the extent of surface covered by the tides is such as to permit an effect upon their motion caused by the winds. The sands of which the bed is composed are therefore subject to a change of place, and hence the positions of the shoals are ever liable to variation.

From this circumstance the channel or line of deepest water varies also, and becomes divided in various places; so that instead of one permanent course, having a depth which is due to the natural force of the descending waters, several channels are formed, of which neither can be of the depth, that in a single channel, would be maintained.

There can be no doubt that the condition of a river is best for the purposes of navigation, when the deepest part is limited to one permanent and regular track. This can be effectually obtained only by causing the flowing and ebbing waters to act in the same lines; such a condition may not be practicable where the scale of the river is of so great a magnitude, that the motion and action of the water is influenced by winds.

The *principle*, however, should be kept in view, and should be approached as nearly as the means extend. A regularity in the outline or borders of the river is essential for the production of the effect required; and while the opposite banks of the Mersey remain as they now are, totally inconsistent with each other, we cannot hope for the improvement so much needed, and which is obviously within the power of art greatly to assist.

* It was our original intention to have published the discussion, but it extended to such a great length that we were obliged to abandon our intentions. —Ed.

But to obtain that degree of regularity or parallelism which is required, certain excrescences in the area must be enclosed, by which it will become reduced. It is to the consequences of such a measure that the numerous opinions before adverted to were directed, and which have now to be considered.

It has been asserted that the open broad areas of the river at a considerable distance above Liverpool, are necessary for the maintenance of deep water towards the river's mouth; and it is thence inferred that if the area of the river towards the extremity of the tideway were diminished, great injury would be sustained towards the outfall.

The shoals are said to accumulate, and the depth of the channel diminish; and a great proportion of such effects have been attributed to the enclosures that have been made from the river in the upper part of the tideway.

In order to investigate the subject in question fairly, it is indispensable that the *source from whence the accumulations are derived be ascertained*, (*i. e.*) it must be known whether the materials which constitute the accumulations for the most part are derived from the sea shore, os whether they are brought down by the rains from the surface of the uplands?

That matter is brought from the interior and carried towards the sea, is a fact too well known to require more than allusion to it. But that the quantity so brought down and deposited in the bed of the river is scarcely perceptible, and that it does not produce any sensible injury, may, I think, be demonstrated in a satisfactory manner. It must then follow, that the accumulations complained of are *supplied from the sea.* I have confidence in being enabled to prove *that the great expanses in the area of the upper part of the river, are not only not beneficial to the outfall, but that they are injurious to it.*

If the accumulations were derived from the uplands in any sensible degree, the quantities deposited from time to time might be expected to bear some proportion to the quantities of rain fallen at different periods, because the quantity of matter brought down and conveyed through the upper division of the river to the tideway, must be regulated by the quantity of water which conveys it. But it is a fact long ascertained and known beyond doubt, that the accumulation of the sands in the vicinity of Runcorn (above and below that place) *is greatest when there is least water descending from the uplands.* Such is the amount of accumulation in *one dry season*, that it is felt by those who navigate the upper part of the tideway. It is then to be observed, that the accumulations progressively increase until the arrival of a land flood, on which occasion the excess that had become deposited is removed. The fact therefore is, that the quantities of accumulations in the river are inversely in proportion to the quantities of rain; and hence there is less deposit upon the bed of the river in the tideway when the greatest quantity of silt is brought down from the uplands. From this reasoning we may infer, that if there were no descending land stream, and if the whole area of tideway were a *mere bay*, the same would gradually silt up, and become dry land. Such would be the fact, and it will be shown that however extensive the receptacles for the mere tidal waters, they do not contribute to the preservation of the outfall.

The cleansing of the outfall is admitted by all to be dependant upon the force of the *outward* motion of the water. It must therefore follow, that the *inward* motion of the same (*i. e.* the flowing tides) will act in a similar manner, and bring with them such quantities of sand as they are capable of moving. The question then refers to the comparison of the *inward* with the *outward* forces. If the force of the ebbing tide do not exceed that of the flowing tide, it is evident that no greater quantity of sand can be carried out by the former than that which is brought in by the latter. If the ebbing water have an excess of power over that which flows, it is certain that a greater quantity of sand will be carried out than is brought in, and consequently *the depth must gradually increase.* But such, however, is not the fact, *although the ebbing tides are assisted by the waters from the uplands.*

From what has now been stated, I trust it will appear manifest, that the *effect* of the flowing tides in raising the bed of the river, exceeds that of the ebbing tides, and hence we may conclude, that *the depth of the channel is entirely and exclusively dependant upon the water derived from the uplands.*

Although I cannot imagine a doubt upon the fact just mentioned, the subject is of so much importance, that I must beg permission to make use of another argument.

If the deposits in the tideway were derived from the uplands, we surely ought to detect the fact by reference to the substance of which they are composed. I have obtained specimens of the bed of the river from various parts of it, and have found that the substance in the higher part of the tideway corresponds with that taken from below Liverpool. I have also found that the loose matter in the bed of the river above the tideway, has a different character. It is true that the strata of the district through which the river passes from its source is silicious, and, therefore, the debris partakes of that character; but in form it differs, and, as may be supposed, is mixed with various other substances, of which coal dust and soot may be taken as prominent ingredients. Now, the difference in colour of the general mass of specimens taken from the higher part of the river, especially that near Manchester, and that of the specimens taken from the neighbourhood of Runcorn and Liverpool, is such, that no doubt remains of their being derived from different sources.

Considering the character of the district through which the river passes, the immense consumption of coal on both its banks, and the prodigious quantity of loose coloured matter that must necessarily be washed into its stream, I certainly did expect to find some appearance of such matter in the sands in the vicinity of Liverpool, but although I employed a very high magnifying power, no such particles could be detected.

We have also abundance of examples, which prove most obviously, that with tidal rivers the raising of their beds is produced by the flowing tides, while the products of the land waters are *not observable until the tides have elevated the surface to nearly the height to which they rise.* The dimensions of the particles, a descending stream is capable of carrying, depends upon the velocity with which the water moves, and that velocity is determined by the slope of the bed. Most rivers appear to be progressively diminishing in depth, and hence we may safely infer, that their depths towards their outfalls were greater in proportion to the remoteness of the periods; their slopes must therefore have been greater, and the masses brought down proportionally so, and the debris derived from the uplands and deposited in the rivers must increase in dimension in proportion to the depth at which is is found. Although the common velocity of a river may be insufficient for the removal of gross particles, (say coarse sand,) it may be sufficient for carrying matter of a lighter description, and it is probable that all such light matter as arrives in the tideway of the Mersey, during the ebb-tide, is actually carried out to sea; but such as may arrive during the flood-tide, which at high water does not happen to be deposited on those parts of the bed over which a current passes when the tide returns, will *remain where it falls.* Now this can only happen where the sands have accumulated to a considerable height from another source before described, and it seems that the deposits from the uplands in the process now going on in the Mersey, are for the most part of the lightest description, and they are to be found only under the circumstances mentioned. All this reasoning is sufficiently supported by an examination of the soil of which the upper portion of the marsh land is composed, and may therefore be safely relied on.

The coasts of Surry, Kent, Suffolk, and a portion of Norfolk, are bordered by beaches of shingle, which are kept in perpetual motion by the action of the sea, and the component parts are continually seeking a place of shelter, and hence they enter and accumulate about the mouths of all inlets which have not the advantage of an opposing force, derived from a never-failing stream from the uplands. The direction of their prevailing course is determined by that of the most frequent or prevailing action of the waves, or breakers of the sea, and although a land stream be sufficiently powerful to maintain a passage to the ocean, yet such is the action upon the loose substances which compose the shingle, that their motion cannot be prevented, and the outfalls of the rivers become diverted into a direction parallel with the shore, unless such an effect be opposed by artificial means.

If, then, notwithstanding the existence of the constant aid of a land stream, it be difficult to retain an unencumbered outfall, much less can it be expected that a clear opening shall be preserved where such assistance is not available.

Leaving the operations of nature entirely free from control, it does appear that all inlets upon a coast invested by a shingle beach, and which are not preserved by the discharge of a stream from the land, must gradually diminish. The accumulating process is abundantly exhibited on the coasts alluded to. Dovor, Folkestone, Rye, and Shoreham, afford excellent instruction upon the subject.

Nothing is more common than to assign, as the cause of decay in harbours, the enclosure of spaces which previously received the tidal waters, while the ordinary processes of nature are totally unheeded. I have never yet heard any reasoning which explains in what manner the abstraction of the tidal space can or does produce the effects complained of. If the flowing and ebbing forces be equal, the latter can only remove from a harbour the same quantity of matter the former may have deposited.

But upon careful examination of all the actions contained in the process, it will be seen that the flowing forces are the greatest, and hence we need seek no further for causes that produce the effects which we observe and lament.

But an approach to parallelism in the banks, is useful in another way: the tapering form of the opposite sides is known to contribute to the advancement of the tides towards the extreme points of their access. *The spring tides at Runcorn do now rise to a higher level than the high water mark of the same at Liverpool, while some neap tides, if opposed by the wind, will not reach that place.* In the latter case the tides at Liverpool return before the whole estuary has been filled, which would not occur if the area were to be diminished to its best proportion, and the sides properly regulated.

Very remarkable and interesting evidence on this branch of the subject is to be found in the Severn and Wye. The channel of the Severn is *funnel-shaped*, and the height to which the water rises increases with the distance reached; thus—

At Swansea a spring tide rises	30	feet
At the mouth of the Avon ..	40	„
At the New Passage.........	50	„
At the mouth of the Wye ..	60	„
At Chepstow...............	70	„

Some portions of the rise at Cheptow may, however, be ascribed to the quantity of water descending from the mountains. These facts I have personally ascertained.

Now although the Mersey is of a different form from the Severn, yet it may readily be conceived that the momentum of this great body of water in the river below Runcorn, must, where the space is suddenly contracted, as it

is at Runcorn Gap, cause a swell, and it therefore flows to a greater perpendicular height at Runcorn Docks than its natural level at Liverpool. This effect has, as before stated, been limited to spring tides, the neaps being contrary.

Mr. Bateman's Report to the Company of Proprietors of the Mersey and Irwell Navigation.

Gentlemen—In my recent investigation at Runcorn, as to the best means of improving the navigation there, I was led to the consideration of the general improvement of the river Mersey, and particularly of that part which lies between Runcorn and Warrington. A mode of effecting this in a manner which appeared to me likely to be beneficial to every party interested, suggested itself; and, in the belief that it is deserving your attention and consideration, I take the liberty of laying it before you.

The improvement of the river for navigable purposes is a subject of great importance to the proprietors of the navigation—to the town of Warrington, and to all who can participate in the advantages which may be expected to result. It is a subject which has frequently excited the most serious attention, and it appears recently to have been taken up with a spirit from which some practical and useful result may be confidently expected.

The river possesses within itself the means of very great improvement; and I am convinced, that, if these resources were sufficiently investigated and developed, no great length of time would elapse before we should see vessels of three or four times the present burden, unloading their cargoes at the quays of Manchester.

It is becoming of daily increasing importance, when we consider the vast impetus which must be given to the trade of Manchester and its neighbourhood, by the many important railroads which are now constructing—the great increase in the carriage of merchandise which may consequently be expected—the important benefits which the Inland Bonding Bill, if suffered to pass into a law, will confer upon the town, and the probable increase in the carriage from that cause also—with the necessity of carrying the facilities of inland navigation to the highest pitch of perfection, in order to cope with the powerful rivalry of collateral railroads.

The river, as far as the navigation extends, may be considered as naturally divided into three parts; from Liverpool to Runcorn; from Runcorn to Warrington; and from Warrington to Manchester.

The first is a wide and open estuary or inlet from the sea, navigable at high water of all tides, for vessels of considerable burden; and being from its nature susceptible of little improvement beyond the deepening and straightening of the channels. At high water, it is for the most part from two to three miles in width; but, at low water, the channel is generally not more than 200 or 300 yards. Upon this portion of the river, steamers ply regularly at every tide, between Liverpool and the various canals which enter the river near the town of Runcorn, for the conveyance of goods and passengers, and for tugging vessels; and it forms the utmost extent to which the natural navigation of the river, assisted by the tides, can be regularly and certainly made.

The second division forms the upper end of the estuary, separated from the lower part by a narrow strait called Runcorn Gap, where the opposite rocky shores approach to within about 400 yards of each other, projecting considerably within the limits of high water, both above and below. It is nearly a mile wide at the lower end, and terminates upwards in the ordinary channel of the river, which is probably about a hundred yards in width. It is only navigable at high water of spring tides, for vessels of more than 40 or 50 tons burden, and has been found so beset with inconveniences and difficulties, that the navigation of it has been nearly abandoned, artificial canals having been constructed inland, for the purpose of carrying on the communication.

The third portion lies above the reach and influence of the tides, and is strictly an artificial river navigation, having been rendered available for that purpose by locks and weirs, to the town of Manchester, and shortened and straightened in various parts by artificial cuts. It is only now, however, capable of being used by vessels ordinarily about 40 or 50 tons burden, drawing about four feet of water. The depths of the pools vary considerably, being in many cases 10 or 11 feet, and in others not more than four or five feet.

The navigation of this part is capable of being greatly improved, and may be adapted at a reasonable expense to the conveyance of vessels of 150 tons burden, or probably more.

Several bridges would prevent the passage of high-masted vessels; but all steamers, and such vessels as could sufficiently lower their masts, might make the entire navigation. This is perhaps now of less importance than it would formerly have appeared, as, from the rapid progress steam navigation has recently made, we may reasonably expect a very large proportion of the trade will be carried on by that means; while, to a considerable extent also, vessels expressly adapted to the circumstances of the navigation, would no doubt be constructed. A survey for the purpose of reporting the most effectual means of accomplishing the improvement of this part of the river is now in progress, and I have little doubt the report will be of a very satisfactory nature.

The main difficulty in the way of a general improvement to the town of Manchester, so as to take vessels of the size above mentioned, appears to exist in the inconvenient state of the navigation between Runcorn and Warrington; and it is to the improvement of that portion of the river that my attention has been particularly drawn, and to which I shall confine my observations.

Whether any definite plan for the improvement of this part, or the removal of its natural difficulties, has ever been proposed, I am not aware; but from the opposition with which all attempts to carry bridges over the estuary at or above Runcorn Gap have been met with, and from the jealousy with which any encroachment on the tideway has been watched, the general impression seems to have been that it was necessary to keep it in its present state,—that of an open unobstructed tidal river.

I rather think there has been generally a kind of vague idea, that some important plan of improvement would sometime or other be projected, and an apprehension that any alteration in the river might tend to prevent the accomplishment of the anticipated scheme; and, therefore, all parties have been particularly anxious to keep it in its natural and original state.

The examination I have made of the river with information obtained respecting it, and a careful consideration of all the circumstances connected with it, have led me, however, to the conclusion that so long as the river above Runcorn remains an open estuary, washed over by the tide, it will be impossible to effect (except at an enormous expense) any advantageous or permanent improvement.

The main difficulties under which this part of the navigations labours, are want of sufficient depth of water to carry vessels of any size up to Warrington, except during high spring tides—the short period of time during which it can even then be done—the circuitous and ever-changing channels—and the constant alterations of the sandbanks which are operated on and shifted both by tides and land floods.

To remove these difficulties—to secure a constant and unchanging channel of sufficient depth to allow nearly all vessels to go up to Warrington at any state of the tide, that can reach Runcorn Gap—to give a longer period of time during which the navigation can be made—to do away with the danger and annoyance of being neaped on sand banks, as at present—and to do all at a reasonable and warrantable expense, and so as not to injure the navigation of the port of Liverpool, nor injuriously to affect any other interest, is the end to be desired, and the end which, I hope to be able to show, the plan I have to suggest will be sufficient to attain.

I have mentioned, that the width of the river at Runcorn Gap is about 400 yards, and it is bounded at each side by precipitous rocks. The tides here, even when pressed by strong winds, never rise more than 20 or 21 feet; and at low water the greatest portion of the channel is dry, there being little more than a few feet of water in any part.

The plan I have to propose is to throw an embankment across the river at this place, with proper and sufficient locks and flood gates to admit and discharge the tidal waters under certain regulations.

Were the question merely confined to the best means of improving the navigation from Runcorn upwards, without reference to any effect to be produced below, a simple embankment or weir, with self-acting flood-gates to admit and impound the high tide water, with such locks as might be necessary for the navigation, would be all that would be required; for by that means you would have a pool constantly filled, deep enough to float vessels to and from Warrington, at every hour of the day, drawing 12 or 14 feet of water.

But it becomes a question as to how far the obstruction to the flow of so much tidal water, with its scouring effect upon the channel during ebb tide, would affect the entrance to the port of Liverpool, or the navigation from Liverpool to Runcorn; and I am of opinion, that, unless measures were adopted to prevent it, an embankment only, which would constantly keep up the water, would have an injurious tendency.

To prevent this, and for the purpose of always maintaining a deep channel (and I believe in a more effectual manner than can now be done), I would propose the construction of sufficiently capacious flood-gates to discharge at half-ebb of spring tides, when the most effectual scour is going on, the whole body of water which is impounded, refilling the pool at the next tide.

Having thus stated generally the nature of the plan, I will proceed to explain it more in detail, to point out what I consider its advantages, and to investigate the objections which, it appears to me, may be urged against it.

The average height of the tides at Liverpool over the old dock sill, is about 15 feet,—the highest being about 21 feet, and the lowest 10 feet. These measured from low water are respectively about 33 feet and 23 feet.

An 18 feet tide at Liverpool, being an average spring tide, and about 30 feet in the river, will rise about 15 feet at Runcorn, and 8 feet at Bank Quay, near Warrington.

Such a tide will allow vessels drawing 13 feet to reach Runcorn, and such as draw 8 feet, about 100 tons burden, to go forwards to Bank Quay. A neap tide will scarcely bring a vessel drawing 8 feet to Runcorn, and it will carry nothing at all (but a flat, perhaps) to Warrington.

The average of vessels drawing the greatest depth of water which reach Runcorn, may probably be taken at 10 feet, varying from 100 to 200 tons burden; and this size includes nearly all the coasters, those engaged in the Irish provision trade, and steamers.

At present, such vessels can only get forward to Warrington, at the very highest spring tides, perhaps two or three times in the course of the year; but, by the plan suggested, they will be able to do so as often as they can reach Runcorn; and, when once at Warrington, all steamers, and such vessels as can lower their masts, may go on to Manchester, when the necessary improvements on that portion of the river are effected.

It seems that the difference in the depth of water between Runcorn and Bank Quay at high tide, is about 7 feet. Of this I am inclined to think 4 or 5 feet is attributable to the natural declivity of the ground, and the remaining 2 or 3 feet to the fall in the surface of the flood tide, which, I apprehend, never attains the same relative height at Bank Quay as at Runcorn. If I am right in this conjecture, the effect of an embankment will be as follows:—

A tide rising 15 feet at Runcorn will (as I have shown before) give, as the river is at present, 8 feet of water at high tide at Bank Quay; but, supposing this tide to be retained at Runcorn, and prevented from flowing back, the water would gradually level itself, by rising at Bank Quay, and falling at Runcorn, and if the width of the river were the same from one end to the other, and the difference to begin with was 3 feet, it would rise 1 foot 6 inches at Bank Quay, making the depth of water there 9 feet 6 inches, and fall the same amount, 1 foot 6 inches at Runcorn, reducing that depth to 13 feet 6 inches. As the river, however, is much wider at the lower than the upper end, the fall at Runcorn would be less than half the amount of the difference, and the rise at Bank Quay more than half,—making the depth there probably 10 feet. Suppose further, that the land or river water was allowed to flow

into the pool, so as to raise the entire surface to the level of the original tide, 15 feet at Runcorn, which would occupy about a day and half, there would be a depth of 11 feet at Bank Quay; and, supposing the river is then allowed to flow on through the pool as usual, we must add the fall or declivity in the surface necessary to give it the requisite velocity;—this would be about 2 or 3 inches in a mile, and the distance being, say 7 miles, we should have an additional depth of from 1 foot 2 inches to 1 foot 9 inches to add, making the total depth at Bank Quay from 12 to 13 feet, being a gain of from 4 to 5 feet depth of water.

As this depth is 2 or 3 feet more than is required to float a vessel of 10 feet draught, it will be sufficient if we retain a tide rising 12 or 13 feet at Runcorn, or 15 or 16 feet over the old dock sill at Liverpool. It is of importance to mark this, as you will perceive by observations I shall have to make upon the scouring power I propose to substitute.

Laying aside for the present any consideration of the effect which may be produced below Runcorn, I can see no objection which can reasonably be urged against it, but the possibility of the river gradually silting up, by the deposition of material brought down by floods. The mode I have to suggest of scouring out the channel, will, I think, almost entirely remove the possibility of this being the case, in the navigable channel; but, even without that, I do not think it would have such an effect. The river would maintain its course and current along the deep, depositing whatever it might bring down on the sandbanks and shallows at each side, where there would be little or no current, thereby gradually raising and preparing for agriculture purposes, an unprofitable waste of sands, washed over now by every high tide by which they are frequently removed and carried into the deeps.

I know many instances of rivers maintaining a distinct course through large lakes; but two, which must be familiar to nearly everybody, will be sufficient to mention. The Rhone through the Lake of Geneva, a distance of 37 miles, and the river Bann, for 18 miles through Lough Neagh, in Ireland; each river maintaining a deep and distinct channel through the entire length of lake. The Rhone, however, and, I have no doubt, the Bann also, forms a delta on first entering the lake.

I think that, generally, the channel would be improved; and if deposit was to take place in the upper part of the estuary, where the river would first enter into comparatively still water, it might easily be removed by dredging.

The benefits to the town of Warrington, in particular, must be too obvious to need any remark. The Sankey Canal would obtain a much better entrance than it has now; and the Mersey and Irwell Company would have so much of their navigation permanently improved, and rendered available for a large class of vessels, which they may then take on to Manchester.

We now come to consider the effect which may be produced upon the channel below Runcorn Gap, and upon the entrance to the port of Liverpool.

It would be of little use to suggest plans for the improvement of the upper part of a river, if the mouth were to become so choked up that no vessels could enter; and, in the maintenance of a good entrance to the port of Liverpool, the Mersey and Irwell Canal Company is as vitally interested as any other party can be.

I hope to be able to show, that, so far from the suggested works being likely to do injury, they will assist in scouring out and deepening the channels all the way out to sea.

Much evidence was given, in the trial betwixt the Old Quay Company and the corporation of Liverpool, in 1827, relative to the scour of the river; and from that it appears, that the most effectual in cleansing and deepening the channels is that produced by the ebb tide, when about half down, and the land floods; the latter losing much of their power, however, in the lower part of the estuary.

As this accords strictly with my own observation, and the information of those connected with the river and daily navigating it, I have no hesitation in taking it as the fact.

It appears, then, that the early part of the ebb tide is of little service in improving the navigable channels of the river; and indeed this must be obvious, when it is considered that the water is then running with pretty nearly equal velocity over the whole bed of the river, and removing probably more sand from the banks into the channels than it carries out of them.

Now, if any considerable portion of the water that is thus wasted, as it were, could be retained until the tide was half down, and then set at liberty, it would have the effect of keeping up the river for some hours longer at the most effectual scouring point, and be thus enabled to work deeper into the channels, and carry the sand or slit removed further out to sea.

I think I can make it clear, that this will be the result of the scheme proposed during spring tides, and that, during neap tides, or whenever prevented from flowing beyond the gap, the water will rise higher at Runcorn than it can now, and consequently increase the velocity of the ebb. In either case there will be a strong tendency to improve the channels both above and below Liverpool. The estuary will contain, to begin with, nearly if not quite as much tidal water as it does now, and under regulations which will render it of more effectual service, while eventually the improvement of the deeps will enlarge its capacity.

The upper part of the estuary and river, from Runcorn Gap to Howley Weir, at Warrington, containing at high water of spring tide (including Halton Marsh) about 1,300 acres, is about 1-17th of the entire area of the estuary above Rock Perch. In spring tides, at high water, it contains from 1-25th to 1-30th, and in neap tides from 1-40th to 1-50th of the whole body of water.

Mr. Giles, in his evidence for the corporation at Lancaster in the suit before referred to, calculates the contents of the river at ordinary spring tides, from Runcorn to Warrington Bridge, at 10 1-3 million tons, or about 13,733,000 cubic yards. As a 15 feet tide at Runcorn falls 8 feet to half ebb, considerably more than half the quantity has flowed out before that time, so that the remainder, say six million cubic yards, is the only portion that is effectually employed in scouring the deep. As this is six hours in ebbing out, the velocity becomes so trifling towards the end as to be ineffectual.

In neap tides the effect is proportionably less.

The late Mr. Nimmo, in his evidence for the company in the same cause, gives from actual measurement the ordinary flow of the river above Warrington, and the depth of a very heavy flood over Woolston weir, from which I have been able to ascertain its volume.

From Mr. Nimmo's observations, the fair average of the ordinary quantity may be taken at 40,000 cubic feet, or 1,480 cubic yards per minute.

The flood appears to have been about 580,320 cubic feet, or 21,493 1-3 cubic yards per minute, or nearly one million and a half yards in a hour,—probably nearly equal to the tide at half ebb. It was running at the rate of 113 yards in a minute, or nearly four miles an hour.

It is half ebb at Runcorn rather earlier than at Liverpool; and from half ebb to the commencement of the flood tide at Liverpool, there is about three hours. It is during this period that I would propose to discharge the water which would be retained above our embankment.

I have stated, that a 15-feet tide at Runcorn has fallen eight feet, or to half ebb. If flood-gates were constructed in the bank, 60 yards in length, 8 feet in depth, and opened at half ebb so as to obtain an average pressure of 8 feet to the bottom of the discharge, the quantity discharged in the three hours would be nearly six million cubic yards, or about the whole quantity now contained in the estuary with a similar tide at half ebb, and requiring six hours to flow out.

If the discharge sluices occupied 100 yards in length instead of 60, being then 1-4th of the width of the gap, the discharge in the three hours would be more than nine millions and a half cubic yards, being half as much again as all the water now left in the estuary at half ebb, and more than 2-3rds of the whole contents measured at high water of spring tides, and nearly equal to the whole quantity at half ebb added to three hours of such a flood as Mr. Nimmo mentioned. The discharge would be at a velocity of 10 feet per second, or nearly seven miles an hour, and would, after mixing with the other water, maintain a velocity of three or four miles much greater than the mean velocity after half ebb at present.

There cannot be a doubt, I think, that, under such regulations, the scouring power would be greatly increased; and, while below the gap, the direct force of this power would be employed in deepening the channel and carrying out the sand and silt to sea, the velocity of the current above the gap would be so much increased and confined to a particular direction, that the channels there would also be deepened, and any casual deposit carried out; so that, independent of other improvements, the channels of the whole river would be improved from Warrington to the sea.

After these discharges the pool might be refilled at the next tide, or whenever the tide rose more than 13 feet at Runcorn. At the lowest spring tides, for three or four days together, and at the highest, for seven or eight days together, perhaps twice each day, but at any rate every alternate tide, much less frequently than this would, I am satisfied, be found amply sufficient.

The next point is, that, by the tides being prevented from flowing beyond Runcorn Gap, they would rise higher there, and, by thus attaining a greater head or elevation, which will be another advantage besides, would produce an increased velocity in the ebb.

The tide flows past Runcorn at the rate of five miles an hour; and if stopped there by an embankment, and prevented from flowing up to Warrington, and filling that part of the estuary, the momentum, which impels it forward for an hour after it has turned at Liverpool, would cause it to impound in front of the embankment. From calculations I have made, I am disposed to think that the additional rise would probably be about 1-20th of the total depth of water, or from four to nine inches, according to the height of the tide. This amount, small as it appears, would be of service in neap tides.

I have now, I think, gone over the main points which appear to me materially to bear upon the question; and I hope I have succeeded in explaining them in such a manner as to render them intelligible, and enable you to understand my views.

If I am any thing nearly right in the data I have taken, and the conclusions I have drawn from the calculations I have made, the advantages in every point of view must be considerable, nor are these advantages confined to the navvigation only; the adjoining landowners may reclaim a large portion of the land above Runcorn, which is now covered at high tides; a good road, with draw or swivel bridges over the locks, may be formed on the top of the embankment, and thus join the two counties of Lancaster and Chester in a very much superior and more convenient manner than is now afforded by the dangerous and inconvenient ferry. Even a railway viaduct, if carried at a sufficient height, would then be no objection; and many miles of railway travelling might be saved to the London and Liverpool traffic, by crossing here, and joining the Grand Junction at Prestonbrook.

It only remains to explain shortly the kind of works which would be required.

The width of the strait at Runcorn Gap is about 1,250 feet. The bed of the river consists of about 35 feet of rock on the Cheshire side, dry at low water; about 745 feet of sand and silt in the middle of the river, extending, I believe, to a considerable depth, partially dry at low water; and about 470 feet of rock, all above low water, on the Lancashire side. The rock extends inland on each side, rising considerably, particularly on the Cheshire side, above high water level.

I would propose to construct two sea locks *in* the rock on the Cheshire side; one 180 feet by 40 feet, and the other 120 feet by 30 feet, with hydraulic gates, so that they may be self-acting, and used for the purpose of scouring. In the rock on the Lancashire side, I would recommend the construction of the self-acting flood-gates, and between the limits of high and low water there is ample space for *ten*, with 30-feet clear water openings in each; the gates to be revolving on an upright axle, placed a little on one side of the centre, so that one leaf of the gate should be rather larger than the other. The gate, of course, must open only one way, the larger half turning *up* the river: when, therefore, the flood tide rises higher than the surface of the water on the upper side of the gates, the pressure being greater upon the larger leaf than the smaller, the gate opens, and the water is freely admitted. When the tide has reached its greatest height, and begins to fall, the pressure

is then reversed, and the gates closes, retaining all the water that has flowed past the embankment. To open the gate, and discharge the water *en masse*, various methods might be adopted. The simplest, perhaps, would be to draw up out of the larger leaf a paddle of sufficient size to make the smaller leaf expose a greater surface to the pressure of the water, when, of course, the gates would open by the down-stream pressure, as they would in the other case by the up-stream pressure. The paddles may be worked by self-acting balance weights, or by a water wheel set in motion by the fall of the tide, so as to make the whole self-acting. The water, after its discharge, may be directed by proper jetties into the channel required.

Over the intermediate space of sand and silt, betwixt rock and rock, I would propose an embankment composed of rock and earth in the manner shown in the drawing; the centre of the bank of puddled earth or clay; and the outer parts of rock faced with heavy squared pitching brought up from low water in a curved manner, as shown in the drawing. In order to secure as far as possible or necessary the water tightness of the bank, I would recommend a row of sheet piling perhaps 25 or 30 feet deep on each side of the puddle wall in the centre of the bank, and at the foot of each slope another row of shorter piles, to prevent the pressure of the bank forcing out or blowing up the sand foundation.

A carriage road to be formed over the whole, passing over the locks by draw or swivel bridges, and over the sluices by stone or wooden arches.

This plan, with 15 feet of water impounded, would afford a sectional area of discharge of 5,970 square feet. The calculations in my report are made upon an area of 2,400 square feet only, so that, if by that amount the scouring power was trebled, it would, by using all the means which the locks and sluices of the plan just detailed afford, be increased more than seven-fold.

At a ten feet tide at Runcorn, the sectional area of the stream is now about 9.800 square feet. The locks and sluices would afford at the same height about 4,120 square feet. Although this is less than half the present sectional area, a difference in level of considerably under a foot would so increase the velocity through the sluices as to pass the same quantity of water.

WARMING BUILDINGS BY HOT WATER.

The subject of warming buildings by hot water having lately excited a more than ordinary degree of interest, owing to the recent disastrous fire at Manchester, we lay before our readers a report made to the Manchester Fire Assurance Company, by Mr. John Davies, M. W. S., and Mr. G. V. Ryder. (We shall continue the subject in our next.)

"Before we proceed to detail the experiments which we have made, we shall briefly describe the appearances observed, and the information obtained at a few of the principal places which have been visited. We shall then be enabled not only to confirm but to extend the statements in Mr. Ryder's first report.

It has been found, on inspection, that Birch Chapel has, at various times since the occurrence alluded to in the former report, sustained much damage. Wood, matting and cushions have, in a variety of places contiguous to the hot water pipes, been charred to an alarming extent.

With respect to Mr. Barbour's warehouse, farther inquiry has fully corroborated the previous statements of its having been on fire, close to the pipes, at different times and in different places.

Of the Unitarian Chapel, in Strangeways, tne directors are already in possession or information from both Mr. Ryder and Mr. Rawsthorne, and this information seems to leave no doubt as to the injury which has resulted from the use of Mr. Perkins' hot water apparatus.

The heat in the Natural History Museum having been repeatedly stated to vary in different parts of the pipes, and to become, in some cases, the greatest at places remote from the furnace, the fact has been confirmed by our own observations, and by our subsequent experiments. As this circumstance has excited much interest, and been generally questioned, we shall presently endeavour to assign the cause.

The apparatus, which it may be proper to notice in reference to its general form and construction, consists simply of a long, endless iron tube, carried, in different directions, from a furnace to which it returns, and in which about one-sixth of the whole length is inserted and formed into a coil, so as to be sufficiently exposed to the action of the fire. The tube is, at the commencement, filled, or nearly filled, with water, which, by the application of the heat, soon begins to circulate, and, in that way, to impart an increase of temperature to the apartments which it traverses. The dimensions of the pipes are such, that, on the average, eleven feet in length will contain one pint of water. Connected with the principal pipe are two others, which are opened by a screw, one to allow for the ultimate expansion, and both subservient to the introduction of water.

As far as lay in our power, we have made such experiments as occurred to us, repeatedly, and under every variety of circumstance.

Not having any instruments which would furnish speedy and adequate criteria for the determination of high temperatures, we have resorted to the inflammation of combustible bodies, and the fusion of others, depending on the recent and high authority of Professor Graham for the degrees which they indicated.

The ordinary method hitherto resorted to for ascertaining high temperatures in the pipes, is to file a small portion perfectly smooth, and observe the progressive changes of colour which occur. We did not neglect this expedient; and we witnessed, to great advantage, the successive and beautiful tints. As the temperature increased, we were presented first with a straw colour, then a deep bluish purple, and, finally, with a dark silvery hue. The first is said to indicate 450°, and the blue 600°.

In the Natural History Museum we applied our tests, but were enabled to do so only to a very limited and unsatisfactory extent. Mr. Walker, the proprietor of the patent right for Manchester and the neighbourhood, accompanied us to the establishment of Messrs. Vernon & Company, engravers, where we had the opportunity of trying the system rather better, but still imperfectly. Finally, Mr. Walker acceded to our request to have put up, on his own premises, a suitable apparatus, which was to be submitted entirely to our control. It consisted of an iron pipe upwards of 140 feet in length, 26 of which were coiled in the furnace; 20, at least, being freely exposed to the full action of the fire.

In addition to the apparatus, as at first fitted up, we had a branch pipe and a stop cock, which enabled us, by cutting off at pleasure a great portion of the circulation, to perform our experiments on a contracted scale, and under a variety of modifications.

Mr. Walker, being from home at the time, placed his foreman entirely under our directions, so that we had the opportunity of pursuing the investigation to any extent which we might think proper. It is but justice to state, that this person rendered, very willingly and with much practical skill, all the assistance which was required.

The apparatus having, on Friday the 5th ult., been fitted up and found on trial, to be in proper condition, the experiments were commenced on the following morning, at ten o'clock, when the apparatus had arrived at a suitable state.

I. *First class of experiments, viz. those made with the whole length.*

1. The pipe from the furnace became very soon sufficiently hot to singe and destroy small feathers resting upon it.
2. Speedily afterwards, the same pipe exploded gunpowder.
3. On the highest pipe, within a foot of the expansion pipe, bismuth was readily melted, denoting a temperature exceeding 470°. The pressure at this point must have exceeded 35 atmospheres, or above 525℔. on the square inch.
4. Feathers were singed instantly, and matches lighted, at the same place.
5. Gunpowder inflamed readily in various parts of the flow pipe, and on the expansion pipe.
6. Blocks of wood, of five different species, were charred: from the dea wood the turpentine issued profusely.
7. Other combustible materials were also severally much charred.

II. *Class of experiments, with the shorter circulation. By this change a greater pressure was immediately observable, as the expansion pipe and several of the joints emitted steam, and admitted the escape of water.*

1. Cane shavings, on the pipe above the furnace, readily inflamed.
2. Lead melted at the same place; and the temperature must, therefore, have exceeded 612°. Making a rough calculation from the table of the French Academy, which does not extend beyond 50 atmospheres, I take 612° to represent 75 atmospheres, or about 1,125℔ pressure on the square inch.
3. Different wood shavings inflamed on the upper pipe.
4. Cotton ignited freely at the same place.
5. Matting inflamed at the same place.
6. Cotton, hemp, and flocculent matter, collected from Mr. Schunck's fustian room, ignited on the returning vertical pipe.
7. The blocks of wood, tied to different parts of the tube, were much acted upon and charred in a very short time.

Observing the expansion pipe to be in a state of considerable agitation, and warned of an explosion, the temperature was reduced, and the experiments were, for the time, suspended.

The pipes having, before three o'clock, been refilled and screwed up, for the express purpose of an explosion, the following experiments were made in the progress of the preparation :—

1. Mungeet was readily ignited.
2. Different sorts of paper and pack thread were destroyed.
3. Bismuth fused instantly.
4. Cotton inflamed.
5. Sheep's wool became speedily charred, in 2″ or 3″ after the stop-cock closed.
6. At five o'clock the sheet lead, affixed to the upright pipe, freely melted; steam issued violently from the bend in one of the upper horizontal pipes, and, in three minutes afterwards, the explosion occurred in the furnace pipe, at the top of the seventh coil, which presented, on subsequent examination, a lateral aperture about two inches long and about one-sixteenth of an inch broad.

In the lapse of two or three minutes after the commencement of the explosion, the furnace was entirely emptied of its contents, which were propelled, in a divergent direction, like one mass of fire, so as almost to fill the apartment. The force with which the ignited embers rebounded from the opposite wall, and other obstructions, occasioned them to scatter in profusion like a shower of fire over every part of the place. The noise was so great as to bring to the spot a multitude of people from the adjoining streets. A number of articles in the shop—as, for example, packing cloth, paper, and hemp—were subsequently found to be on fire in different parts of the premises.

These appearances, and their immediate effects, seem to have been precisely similar to those which are said to have been witnessed at the explosion in the

warehouse of Messrs. Crafts and Stell, and would evidently have been adequate, in the same situation, to produce all the consequences.

It may be here observed, that the experiments clearly prove, that the heat, in different parts of the pipe, is not uniform. Generally it is greatest at the highest elevation, where its superior temperature appears to be of the longest duration under ordinary incidental changes. At the commencement of the operation, however, and a short time after fresh fuel had been applied, the temperature was highest in the flow-pipe contiguous to the furnace. Another circumstance, likely to produce an inequality of heat, may be adverted to: the tubes are far from being of uniform internal diameter; the consequence of which must be, that as the same quantity of water has to pass, in the same time, through every part of the apparatus, the liquid must move with greater velocity at one place than at another, and thus, from obvious causes, develop a greater quantity of caloric. The difference is sometimes so great in the relative bores of the tubes employed, that in some which were examined, one tube had an internal diameter of 9-16ths, and another of $\frac{3}{4}$ths of an inch, that is to say, in the ratio of three to four; or, taking the relative areas or sections of the tubes, which represent the relative quantities of fluid contained in a given length, in the proportion of nine to sixteen. Thus, taking the velocity reciprocally as the section of the pipe, the velocity of the water at one part of the apparatus being represented by sixteen feet, the velocity in another part would be nine, or the rapidity of the current would be at one place nearly double that which it was at another.

It is stated, in a work recommending the hot water system, that "the application of heat fills" the ascending or flow-pipe "with minute bubbles of steam which rise rapidly to the upper part of the tube, and become there condensed into water again:" now, as condensed steam, wherever it occurs, produces about seven times as much heat as the same quantity of water at the same temperature, we have, at once, a reason for the heat of the pipe being generally greater at a distance from the furnace than contiguous to it. This apparent anomaly, which has been repeatedly observed and denied, admits, therefore, of an easy explanation.

The explosion may, under different circumstances, occur from various causes.

1. As water expands in bulk about five per cent. from 40°, its point of greatest density, to 212°, the boiling point, the expansion must be very considerably more when raised to high temperatures. If, therefore, the pipes be nearly filled with water, and the expansion pipe not adequate or in proper condition, an explosion must be inevitable. Dr. Graham states, that, from freezing to boiling water, the expansion is from 22.76 to 23·76 = 100 to 104·4 nearly.

2. The conversion of the water into vapour, producing an expansion which is in the proportion of a pint of water changed into 216 gallons of steam, "with a mechanical force sufficient to raise a weight of 37 tons a foot high," must present a pressure upon the tubes sufficient to ensure their destruction. Dr. Graham makes a cubic inch of water to expand into 1,694 cubic inches of steam, or one pint of water to become nearly 212 gallons.

3. It has been observed, as an ordinary occurrence, by those much accustomed to the apparatus, that, in some cases, a quantity of gas is generated, and has been found to escape, in considerable quantity, when an aperture is made in the upper part of the pipes. The only gases which could be thus obtained are the elements of the water, oxygen and hydrogen. The former would probably be taken up in the oxydation of the metal. Now the hydrogen gas, which would remain, has never been deprived of its elasticity, and never made to change its state, by any compressing force hitherto applied. It is obvious, therefore, that inevitable danger must arise from its production. It may be worth while to remark, that air, steam, and hydrogen gas expand in the same proportion by augmentations of temperature. The law discovered at the same time, and by independent methods of experiment, arose out of the researches of Dr. Dalton and M. Gay Lussac. It may be thus expressed: Aëriform bodies expand the 1-480th part of their bulk on the addition of each degree of temperature. Thus, taking 480 cubic inches of steam or hydrogen gas at 32°, the mass becomes, at 33°, 481 cubic inches; at 34°, 482, cubic inches; and so on: or, in a general form, a bulk a raised $d°$ of temperature becomes $a + \frac{d}{480}$.

4. The last source of explosion to which it is necessary to refer, arises from any casual impediment in the pipes; and it freely admitted, that in frosty weather such an impediment is likely to occur; it has been found to result from other causes, as in the case of extraneous matter accidentally getting into the pipes, an example of which was recently presented in the establishment of Messrs. Wood and Westheads.

In a very obliging letter received, in the course of the investigation, from Sir Robert Smirke, it is stated, that, though he has "never seen the pipes heated sufficiently to ignite wood, except on one occasion," yet, "if a fire is incautiously made when there if a stoppage in the pipes from frost or other accidental cause, the pipe within the furnace may be burst or made red hot near the furnace. I have known the pipe," he adds, "so heated only in one instance, when the red heat extended to a distance of upwards of 12 feet from the furnace."

Sir Robert concludes his letter by suggesting a protective modification of the apparatus. "Therefore," he observes, "to prevent the risk of fire to a building, I would never place the furnace in a room or cellar that is not fire proof, nor would I have the pipes in any part of their circuit in *actual contact* with wood or other combustible material. Security," he continues, "is still more effectually attained by having a safety-valve upon the pipe near the furnace, by which explosion or excess of heat would be prevented."

That which has happened once, may, under the same circumstances, happen again. The exclusion from *actual contact* with combustible materials, could it be permanently ensured, would, when the red heat extended along the pipe upwards of twelve feet, afford, at least, very reasonable grounds for apprehension.

On this system of warming buildings, therefore, danger must be produced from either negligence in the feeding of the furnace, or any stoppage in the pipes: the former evil may be obviated by proper precautions; but the latter, occurring unexpectedly, exists unobserved, and precaution and care must be equally unavailing."

Signed, JOHN DAVIES,
GEORGE VARDON RYDER.

March 10, 1841.

ON THE STYLE OF WREN.

FOLLOWING in the train of Palladian architects comes Wren, another of the school, though exercising its sentiments in a different way. He took from Palladio the idea of modifications, as also he learned from Jones the art of distribution; but then, he also learned a something of the sentiment of English architecture, and so fashioned a style compounded of them all. Not that he deviated from classic rule, or indulged in a detail inconsistent with the whole. This Wren could not do. But inasmuch as the broad masses of Palladio and Jones, were to be sacrificed to the more modest limits of ecclesiastical structures, he had to prepare his features for altitude rather than for breadth. Instead of the artist having to lead the eye upward, he had now to prevent its too hasty ascent, and had to enchain the fancy here or there, as if to compel the eye to wander where otherwise it would instantly soar. In him we see the first architect of his school for beauty of outline and simple elegance of form. In Jones we view the artist more in his dispositions of effect, more in the skilful appropriation of the parts, than in the finished elegance of the parts themselves. In Wren we see more justness of expression, more attention to parts, and richness more tempered with chastity. Jones was the master, natural and often carelessly so, Wren was the master, designing more by principles, and adjusting leading objects ere the richness of ornament appeared. Jones seemed to delight in masses of light and shade, in bold contrasts, in feeling touches. Wren allowed the form of a part to display its dignity, and allowed the contrast to appear in changing outlines. Both took their lesson from Palladio, but Wren studied symmetry the most. Jones took Palladio's errors and revived them; Wren improved upon both in the outline. He took also from the antique to improve, as he also borrowed from Michæl Angelo to surpass him.

Besides this, Wren was the first to bend Roman architecture into the poetry of the Christian without violence to either. This idea springing up on the decline of Roman art, and differently exhibited at later periods and in the middle ages, was perfected by him until classic orders and figures tapered into every variety of elegance. But the spirit of design in Wren was different from that in the olden times. A departure from Roman precedent was then an innovation, in which the purity of Roman detail was *sacrificed* to new forms and increasing altitude, whereas Wren on the contrary, on the restoration of the Basilica, caught the poetry of the monks only to give life and richness to Roman grandeur. Wren's great aim was to give the eye a succession of pyramidal objects, the moment those objects were separated from the mass; there is otherwise a repose and solemn dignity about the lower parts of his edifice. To carry out this idea involved a variety of figures and a change of ornament, which became as essential to the line of ascent as necessary to enrich. The line of ascent is never broken; the eye easily advances, whilst, as it advances, a change as consistent as various appears to meet it. In St. Paul's there is a total contrast between the lower part and the superstructure. In St. Peter's there is a breadth of parts about the superstructure unrelieved. In St. Paul's the horizontal lines growing gradually less prominent towards the dome terminate into sweeping perpendiculars. In St. Peter's the horizontal is never sacrificed for a moment. In St. Paul's the objects multiply in proportion to the height, as also parts get smaller, that is, divisions and subdivisions of parts appear, whilst each grows narrower and more towards a pyramid. Where Wren grew in endless variety, the architects of St. Peter's only tamely ascended.

Wren therefore was the first who whilst he spread grandeur and massive repose beneath, drew the eye by a thousand artificies into the more pleasing beauties above.

If Palladio gave the same spirited outline to the basilica, Wre

improved upon him by the variety rather than by the number by his contrivances.

Thus far we see the peculiar excellencies of Wren, which whilst they mark him as a Palladian architect, evince an original turn for purity of style. It is to be regretted that the works of the French architects influenced him so much in Winchester palace, and affected his designs for palaces and private buildings, for then there would be no blemish upon his architectural fame. As an ecclesiastical architect he ranks as the first, casting by the brilliancy of his genius Palladio and his other followers into the shade. In conclusion, he differed from Jones materially in the position of lines, conceiving only two beautiful positions of straight lines to exist, namely, perpendicular and horizontal, whereas Jones delighted in oblique positions. He saw the great meaning and beauty in these as they existed in the mansions of Palladio, and traced them, as he did all things, to their derivation—nature.

FREDERICK EAST.

March, 1841.

PROGRESS OF RAILWAYS.

London and Brighton Railway.—The works on this great undertaking are approaching completion at even a more rapid pace than the last report of the Directors gave us reason to expect. Both the Merstham and Balcombe tunnels are finished; and a small portion only of cutting remains to be excavated at the approaches. Mr. Rastrick, the engineer, has engaged to convey a party of the Directors on the line from London-bridge to Hayward's-heath in the course of a month. At Clayton the tunnel is nearly finished; and the line will be completed from Brighton to the Hassocks station in June, leaving only the small portion of the line which extends from the Hassocks to Hayward's-heath unfinished. We are assured that the opening of the line throughout the entire distance will take place by August next.—*Brighton Gazette*.

Manchester and Leeds Railway.—The Summit Tunnel, the only portion of this railway which remained unopened, being completed, this line was opened throughout on Monday. The train consisted of two carriages; both being of an entirely new construction, but somewhat different from each other. The body of one of them is about 18 feet by 7, and is 6 feet 6 inches high. There is a compartment in the centre 7 feet square, and is built after the fashion of a gondola. The interior of this compartment is fitted up with splendid mahogany sofas, lined with crimson plush, and trimmed with silk gymp; and the top part above the sofa boxes is composed of plate glass with silk curtains. The two end compartments are open above; but a curtain made of waterproof fabric can be drawn down at pleasure to screen the passengers from the rain, so that in these carriages a person may enjoy all the comforts of a first-class carriage; and at the same time, be enabled to survey the country through which he is passing. The other carriage, the *Tourist*, is similar in its general arrangements, but is fitted up differently. These carriages, which were made by Mr. Melling, of Greenheys, are adapted for summer travelling; there are but two of them, and they are merely for an experiment. The fares in them will, we understood, be, the same as in the first-class carriages. The first goods train, which passed through, was drawn by an engine called the *Manchester*, made by Messrs. Sharp, Roberts and Co., of Manchester.—*Leeds Intelligencer*.

Manchester and Birmingham Railway.—In the last number of the Journal we announced that the directors of this great undertaking have selected the design of Messrs. Carpenter and Blythe, of London, for their station, and we think this selection is one which will have the effect of adding another fine specimen of architecture to Manchester. The designs have been submitted to public exhibition at the Victoria Gallery. The approach to the station commences in Ducie-street, London-road, from which an inclined carriage way leads on to the railway, which is thirty-two feet above the level of Store-street. The internal arrangements of the station, of which we have been favoured with a sketch, are exceedingly convenient, and appear to combine all the improvements in railway engineering, with the addition of some novelties, for which the directors are indebted to their distinguished engineer, G. W. Buck, Esq. Of these the most striking are, the situation of the engine stable and the construction of the turn table, or apparatus for moving the engines and carriages from one line of rails to another. The engine stable, which will contain stalls for six engines and tenders, is placed at the terminus of the rails, instead of being at a distance from the station, the position usually adopted, by which plan much time will be economised in the dispatch of the trains. By this arrangement the engines, after bringing the trains into the station, can be detached therefrom and turned round without the engine and tender being uncoupled, and then go into the stable to remain there, or to receive coke and water, and return upon another line of rails to the departure side of the station, to take out another train, or proceed to the principal engine depôt at Longsight. This turn table consists of a circular plate of iron, thirty feet in diameter, to be moved by a small steam engine proposed to be erected. The mode of turning the table is very ingenious. Instead of the ordinary method of employing manual labour, Mr. Buck intends to make a portion of the under side of the plate answer the purpose of a pulley, a strap or chain being passed round it, and a fixed pulley in connexion with the steam engine, and by these means the ponderous machine and its load will be moved round with the greatest ease, and the labour of at least half a dozen men will thus be saved.

STEAM NAVIGATION.

The United Steam Frigate Missouri.—From the New Orleans Picayune.—This magnificent vessel is constructed principally of live oak from Attakapas, in this state, and her entire cost is 500,000 dollars. In her rig she will resemble a handsome bark, and her builder has constructed the hull so admirably, as to render her, as a sailing vessel, a No. 1 of the United States navy. She will sail the greater part of the time, as her bunkers only carry about 800 tons of coal, or sufficient for 20 days' steaming. Her spars, particularly the foremost and mainmast, are as heavy as those of a first class frigate; and she is so constructed as to be able to ship and unship her paddle-wheels with the greatest facility. She is pierced for 26 guns, but will carry but 18—6 aft the wheel-house, and 3 forward of it on each side. She is to carry two 10-inch guns forward, which are to traverse the greater part of a circle on a swivel; these two guns will be able to carry shot nearly 100 pounds weight, as 8-inch guns carry 64 lb. shot. The other 16 guns are to be 8-inch bore. On account of the result of various trials, the whole of ordnance is to consist of Paixhan guns. She will be ready for sea in July next.

Taylor's Improvements in Steam Boats.—We have been informed that Capt. Taylor, of her Majesty's ship San Josef, has lately been engaged in a course of experiments in Hamoaze, with a view to the prevention of collisions between steam-vessels, and steam and sailing vessels, such as those which have of late been of so frequent occurrence, and which have been attended with such deplorable loss of property and life. Our informant states that those experiments promise the most satisfactory result. He says that Captain Taylor "has discovered a plan by which the steam boat will be placed completely under the control of the persons on deck, as, immediately danger is seen, the steamer can be stopped, or turned round upon her own centre, and within her own length, without stopping the engine, or calling to the engineer." We have been furnished with some details relative to Captain Taylor's invention, which we withhold for the present, as we understand he contemplates taking out a patent; but should his discovery, when further tested, be found practicable, and should it have the effect of preventing, in future, such melancholy consequences as those which resulted from the late collision between the Nottingham and Governor Fenner, this able and meritorious officer will have rendered a most important service to the interests of humanity.—*Times*.

British Queen and President Steam Ships.—It was whispered in the more select commercial circles on Monday, that the British and American Steam Navigation Company had sold their magnificent ships, the British Queen and President, to the Belgian Government. The President is now on her voyage from America, and will, it is added, have to be surveyed before the contract can be considered definitively concluded; but, if our information be correct, of which we have no doubt, the British Queen has already been "proved," and is, in fact, the property of the Belgian Government. The future destination of the two vessels is scarcely less certain. The Belgians are anxious to push their commerce in every possible way, and we believe it will turn out that the British Queen and President have been purchased with the view of forming a regular steam communication between Antwerp and New York. —*Morning Post*

The General Steam Navigation Company.—The half-yearly meeting of the proprietors was held on Tuesday, the 23rd ult., at the office in Lombard-street. From the report of the directors it was collected that the operations of the past year had been attended with success, and that the affairs generally were in a course of prosperous advancement. Full explanations were entered into upon various points interesting to the proprietors, and appeared to afford much satisfaction. It was resolved, that a considerable sum should be appropriated toward the cost of two large steam ships of 650 and 900 tons, now building by Messrs. Green, Wigram, and Green, and the customary dividend and bonus were declared.

MISCELLANEA.

Artesian Well at Vienna.—For some time past these works had been going on in the vicinity of the barracks in the Corn Market, when, after digging 96 Austrian fathoms, the undertaking was crowned with complete success, in the first week of the present month. The water rushes up in such abundance, that it has been estimated to exceed 12,418 gallons per day, and when it first made its appearance, it was with some difficulty that several shops in the neighbourhood were preserved from inundation.

Artesian Wells in the Oasis of Thebes.—This Oasis is twenty-three leagues in length, and from two to four in breadth, and is studded with Artesian wells, which have been noticed by Arago. The ancient inhabitants used to dig square wells through the superficial vegetable soil, clay, marl, and marly clay, down to the limestone, from twenty to twenty-five metres in depth. The last rock contains the water which supplies the wells, and is called by the Arabs *Agar el moya*. In the rock, holes were bored from four to eight inches in diameter. These holes were fitted with a block of sandstone supplied with an iron ring, in order to stop the supply, when there was danger of inundating the country.

Croieland Abbey.—A new gallery is in course of erection in this sacred edifice capable of accommodating 150 sitters, which, with other improvements made, and in contemplation, will add greatly to the beauty of this truly "majestic pile of Gothic grandeur."

New Pier at Chelsea.—Lord Cadogan has given instructions for a splendid pier to be erected in Cheyne-walk, Chelsea, opposite the place where the Bishop of Winchester's palace formerly stood, and Mr. Lewis Cubitt has taken

the land to open a new street from the water up into the King's-road. The iron steam boats, after Good Friday, will commence running to Battersea, Wandsworth, and Putney.

Asphalte Covering.—The Directors of the Seyssel Asphalte Company, (Claridge's Patent), have made a contract with the Greenwich Railway Company, to cover the arches of their Junction line, to the extent of 240,000 superficial feet. It is also understood that the floors of the several cells of the model prison will be laid with this material.

New Lighthouse at Plymouth.—The ceremony of laying the foundation stone of the lighthouse intended to be built on the west end of the Plymouth breakwater, took place. The weather was delightfully serene, which added much to the interest of the occasion. The stone having been prepared it was lowered into its place, and Rear Admiral Warren, Admiral Superintendent of the dockyard, having plumbed it, spread the mortar, and several coins of the realm were deposited beneath the stone.

Engineering Honours.—We have much pleasure to announce that Isambard Brunel, the engineer-in-chief of the Thames Tunnel, has been knighted by her Majesty; we hope that this is but a commencement of bestowing a few honours on the engineering profession, which we have advocated.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 23RD FEBRUARY, TO 25TH MARCH, 1841.

Six Months allowed for Enrolment.

GEORGE ENGLAND, of Westbury, Wiltshire, clothier, for "*improvements in machinery for weaving woollen and other fabrics, and for twisting, spooling, and warping woollens, also for improvements in the manufacture of woollen doeskins.*"—March 2.

JOHN WILKIE, Nassau-street, Mary-le-bone, upholsterer, and JOHN CHARLES SCHEVIESS, of George-street, Saint Pancras, musical instrument maker, for "*improvements in constructing elastic seats or surfaces of furniture.*"—March 2.

HENRY NEWSON BREWER, of Jamaica Row, Bermondsey, mast and block maker, for "*an improvement or improvements in wooden blocks for ships, rigging, tackles and other purposes, where pullies are used.*"—March 3.

JOHN RAND, of Howland-street, gentleman, for "*certain improvements in machinery for the manufacture of frame work knitting or hosiery.*"—March 6.

THOMAS SPENCER, of Liverpool, carver and gilder, for "*an improvement, or improvements in the manufacture of picture and other frames, and cornices applicable also to other useful and decorative purposes.*"—March 8.

JOHN VARLEY, of Bayswater Terrace, Bayswater, artist, for "*an improvement in carriages.*"—March 8.

JOHN WILLIAM NEALE, of William-street, Kennington, engineer, and JACQUE EDOUARD DUYCK, of Swan-street, Old Kent-road, commission agent, for "*certain improvements in the manufacture of vinegar, and in the apparatus employed therein.*"—March 8.

BENJAMIN SMITH, of Stoke Prior, near Bromsgrove, butcher, for "*an improved apparatus for making salt from brine.*"—March 8.

JOHN WALKER, of Crooked-lane, King William-street, for "*an improved hydraulic apparatus.*"—March 8.

RICHARD LAWRENCE STURTEVANT, of Church-street, Bethnal Green, soap manufacturer, for "*certain improvements in the manufacture of soap.*"—March 8.

THOMAS JOSEPH DITCHBURN, of Orchard House, Blackwall, shipbuilder, for "*certain improvements in ship building, some, or all of which, are applicable to steam boats, and boats, and vessels of all descriptions.*"—March 8.

ANTHONY TODD THOMSON, of Hind-street, Manchester-square, doctor of medicine, for "*an improved method of manufacturing calomel and corrosive sublimate.*"—March 8.

STEPHEN GOLDNER, of West-street, Finsbury Circus, merchant, for "*improvements in preserving animal and vegetable substances and liquids.*"—March 8.

JOHN WERTHEIMER, of West-street, Finsbury Circus, printer, for "*improvements in preserving animal and vegetable substances and liquids.*" (A communication.)—March 8.

THOMAS CLARK, professor of chemistry, in Marischal College, Aberdeen, for "*a new mode of rendering certain waters (the water of the Thames being among the number,) less impure and less hard for the supply and use of manufactories, villages, towns, and cities.*"—March 8.

JOHN BAPTIST FRIED WILHELM HEIMANN, of Ludgate Hill, merchant, for "*improvements in the manufacture of ropes and cables.*" (A communication.)—March 8.

JOHN DOCKREE, of Galway-street, Saint Luke's, gas fitter, for "*an improvement, or improvements on gas burners.*"—March 15; two months.

RICHARD LAMING, of Gower-street, Bedford-square, surgeon, for "*improvements in the production of carbonate of ammonia.*"—March 15.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*certain improvements in machinery or apparatus for picking and cleaning cotton and wool.*" (A communication.)—March 15.

ROBERT WARINGTON, of South Lambeth, Surrey, gentleman, for "*improvements in the operations of tanning.*"—March 16.

JOSEPH MAUDSLAY, of Lambeth, Surrey, engineer, for "*an improvement in the arrangement and combination of certain parts of steam engines, to be used for steam navigation.*"—March 16.

WILLIAM NEWTON, of Chancery-lane, civil engineer, for "*improvements in spinning and twisting cotton, and other materials capable of being spun and twisted.*" (A communication.)—March 16.

GEORGE LOWE, of Finsbury Circus, engineer to the chartered gas company, for "*improved methods of supplying gas under certain circumstances, and of improving its purity and illuminating power.*"—March 16.

CHARLES BUNT DYER, of Pary's Mine, Anglesea, mine agent, for "*an improved method of obtaining paints or pigments by the combination of mineral solutions and other substances.*"—March 16.

LAURENCE KORTRIGHT, of Oak Hall, East Ham, Essex, Esq., for "*certain improvements in treating and preparing the substance commonly called 'White Bone,' and the fins and such like other parts of whales, and rendering the same fit for various commercial and useful purposes.*" (A communication.)—March 17.

WILLIAM THOMPSON CLOUGH, of Saint Helens, Lancaster, alkali manufacturer, for "*improvements in the manufacture of the carbonates of soda and potash.*" (A communication.)—March 17.

HENRY AUGUSTUS WELLS, of Regent-street, gentleman, for "*improvements in machinery for driving piles.*" (A communication.)—March 17.

JOSHUA FIELD, of Lambeth, engineer, for "*an improved mode of effecting the operation of connecting, and disconnecting, from steam engines, the paddle wheels, used for steam navigation.*"—March 22.

RICHARD BARNES, of Wigan, Lancaster, engineer, for "*certain improvements in machinery, or apparatus for raising or drawing water or other fluids.*"—March 22.

ANTHONY THEOPHILUS MERRY, of Birmingham, refiner of metals, for "*an improved process, or processes for obtaining zinc and lead from their respective ores, and for the calcination of other metallic bodies.*"—March 22.

ROBERT WALTER WINFIELD, of Birmingham, merchant and manufacturer, for "*certain improvements in, or belonging to metallic bedsteads, a portion of which may be applied to other articles of metallic furniture.*"—March 22.

ROBERT GOODACRE, of Ullesthorpe, Leicestershire, for "*an improved mode of weighing bodies raised by cranes or other elevating machines.*"—March 22.

DAVID NAPIER, of Mill Wall, engineer, for "*improvements in propelling vessels.*"—March 22.

ACHILLE ELIE JOSEPH SOVITAS, of George Yard, Lombard-street, merchant, for "*improvements in apparatus for regulating the flow of fluids.*" (A communication.)—March 22.

WILLIAM BUCKNELL, of Westminster, gentleman, for "*improvements in applying heat for the purpose of hatching eggs, which improvements are also applicable to other useful purposes where heat is required.*"—March 22.

MORRIS WEST RUTHVEN, of Rotherham, engineer, for "*a new mode of increasing the power of certain media, when acted upon by rotary fans or other similar apparatus.*"—March 22.

ROBERT COOK and ANDREW CUNNINGHAM, of Johnstone, near Glasgow, engineer, for "*improvements in the manufacture of bricks.*"—March 22.

MOSES POOLE, of Lincoln's Inn, gentleman, for "*improvements in stretching cloths.*" (A communication.)—March 22.

JOSEPH WRIGHT, of Carisbrook, Isle of Wight, mechanic, for "*improvements in apparatus used for dragging or skidding wheels of wheeled carriages.*"—March 22.

THOMAS WRIGHT, of Church Lane, Chelsea, Lieutenant in Her Majesty's Navy, for "*certain improvements applicable to railway and other carriages.*"—March 22.

EDWARD FINCH, of Liverpool, ironmaster, for "*improvements in propelling vessels.*"—March 25.

GOLDSWORTHY GURNEY, of Bude, Cornwall, Esq., for "*improvements in the production and diffusion of light.*"—March 25.

ERRATA IN LAST MONTH'S JOURNAL.

Page 75, col. 1, two lines from bottom, for "ærostyle" read "aræostyle."
Page 77, col. 2, line 21, for "as one of" read "is one of."

TO CORRESPONDENTS.

We shall feel obliged if O *of Dublin will favour us with any information respecting the progress of architecture or engineering works in Ireland.*

We must decline inserting any farther communication respecting Mr. Lecount's History of the London & Birmingham Railway, as it will involve us in law proceedings.

Upon consideration we must decline inserting H's *communication respecting the reviewer's observations on Parsey's new work on Perspective; it is a difficult matter for reviewers to please all parties.*

We shall be glad to receive from A Subscriber *at Oxford, the proceedings of the Oxford Architectural Society, and of the Camden Society.*

Communications are requested to be addressed to "The Editor of the Civil Engineer, and Architect's Journal," *No. 11, Parliament Street, Westminster.*

Books for Review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

No. 47.—Grotesque Mask Vase.

No. 62.—Gothic Vase.

No. 108.—Enriched Etruscan Urn.

No. 59.—Oriental Lotus Vase.

No. 119.—From the British Museum.

The same 2 ft. 8 in.

Also without Top, 17 in.

No. 43.—Antique Festoon Vase.

No. 46.—Convolvulus Wreath Vase.

No. 103.—Greek Urn.

The same with Three Handles.

No. 53.—Maltese Vase.

Also one 17 in. high, and 15 in. diam.

No. 101.—Plain Greek Urn.

No. 32.—Bouquet and Mask Vase. (Italian.)

Vase for Ornamental Chimney Pot.

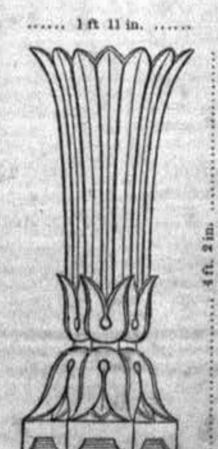
No. 106.—Plain Etruscan Urn.

No. 51.—Maltese Vase.

No. 33.—Bouquet and Festoon Vase. (Italian.)

No. 110.—Draperied Urn.

No. 102.—Guilochi Vase.



No. 56.—Oriental Lotus Vase.

No. 115.—The Bayswater Vase.

No. 112.—Enriched Urn, with Cupids and Lions.

The Prices of the following Vases range from Ten Shillings to Thirty Guineas, Packing extra.

No. 9.—Borghese Vase.

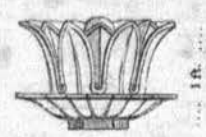
No. 40.—French Foliage Vase with Wreaths.

The same without Wreaths.

No. 11.—Grecian Vase.

No. 70.—The Bishop's Vase.

Also the same quite plain.



No. 99.—Cup and Saucer.

No. 199.—Egham Tazza, and 672.—Small Fluted Column Pedestal.

(For Creeping Plants.)

No. 30.—A Reservoir Vase.
(Maltese.)

No. 14.—Grecian Vase on Plain Pedestal.

No. 65.—Isle of Wight Vase.

Also the same with Wreath of Ivy Leaves.

And another, plain, 15 in. diam.

No. 96.—Tulip Vase.

Also one 17 in. high.

No. 29.—Figured Grecian Vase.

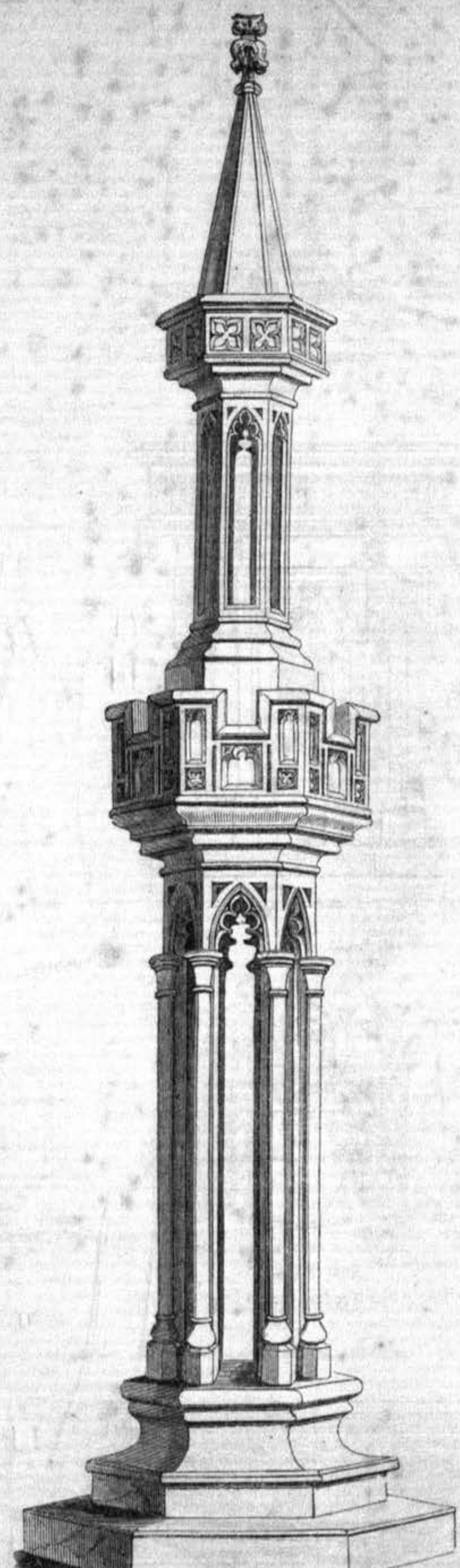
No. 38.—The Warwick Vase.

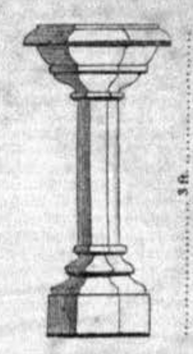
No. 35.—The Tamworth Vase.

Also a Companion.

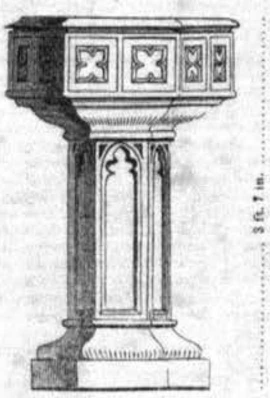
Fonts made to any Design.

No. 552.—Font, with Wreath of Ivy Leaves.
No. 553.—The same, without Wreath.





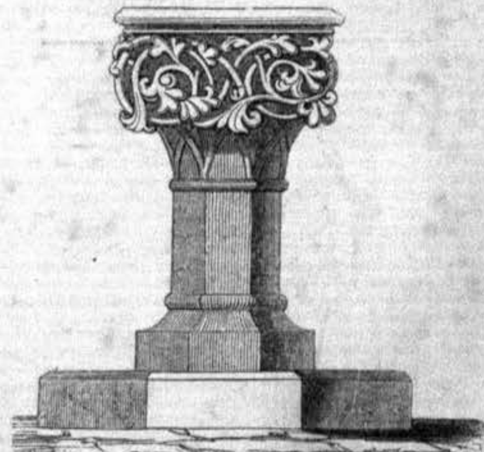
No. 556.—Plain Octagon Font.



No. 559.—Gothic Font,
With large Top, for immersion.

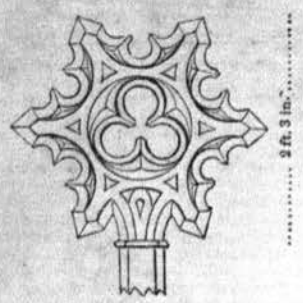
No. 557.—Gothic Font, with Perforated Shaft.
The same, with solid shaft.

No. 547.—Rich Gothic Font.
Designed from Henry VII.'s Chapel.

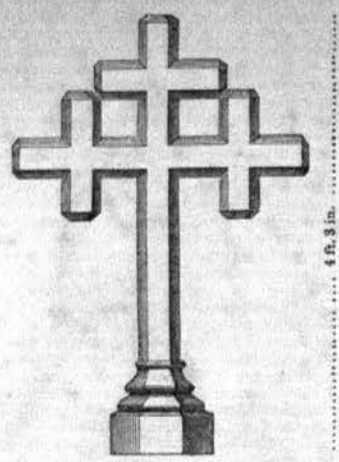


No. 563.—Early English Font.

A. and S. have many other Fonts, slightly varied from the above.

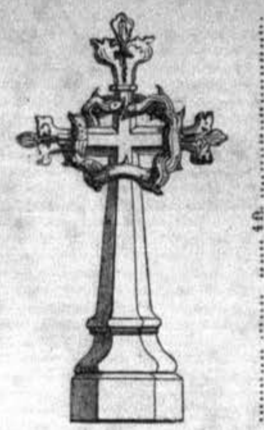


No. 543.

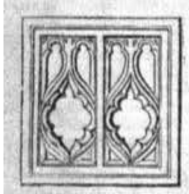


No. 539.

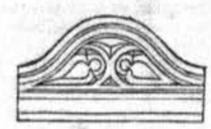
Also Five other Crosses.



No. 540.



HEXAGON GOTHIC FONT.



VERGE BOARD.

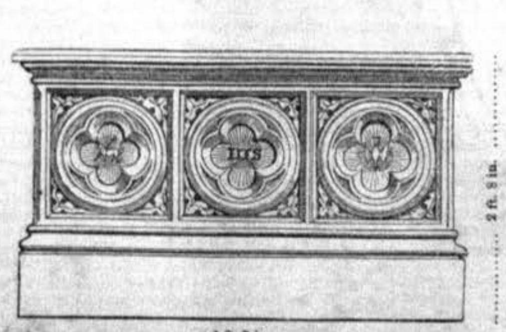
Also several other Finials.

(Drawn to inch scale.)

Nearly One Hundred Corbels and Brackets.

Also other Pinnacles, 3 ft. 7 in.; 2 ft. 1 in.; 1 ft. 2 in.

Also a Gothic Figure



COMMUNION TABLE (the ends plain).

Also the same size, with plain quatrefoil.

4 ft.

THE DOG OF ALCIBIADES.
(Size of the original.)

Also the reverse, and one 16 in. high.

3 ft. 8 in.

THE OLD ENGLISH MASTIFF.

Also several other Dogs.

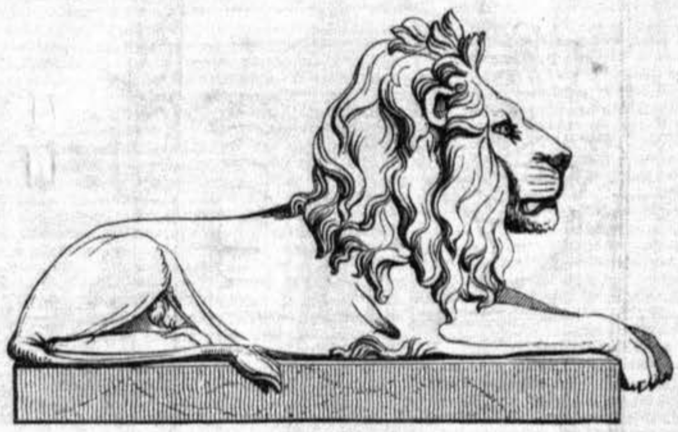
2 ft. 9 in.

2 ft.

Also an Elephant, and other small Models of Animals.

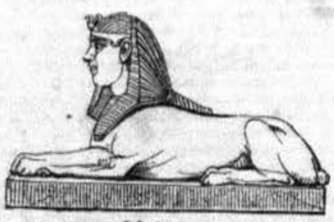
THE FLORENCE BOAR. (Full life size.)

Also the reverse.

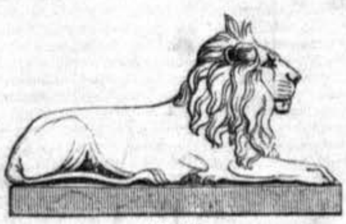


6 ft. 5 in.

Modelled from Nero.



3 ft. 2 in.



3 ft. 3 in.

Also another Model, 7 ft. 7 in.
Ditto, 5 ft.
A Pair of Lion and Lioness sleeping, 3 ft. each.

5 ft. 3 in.

2 ft. 11 in.

Also a large Spread Eagle, 6 ft. 7 in. wide.

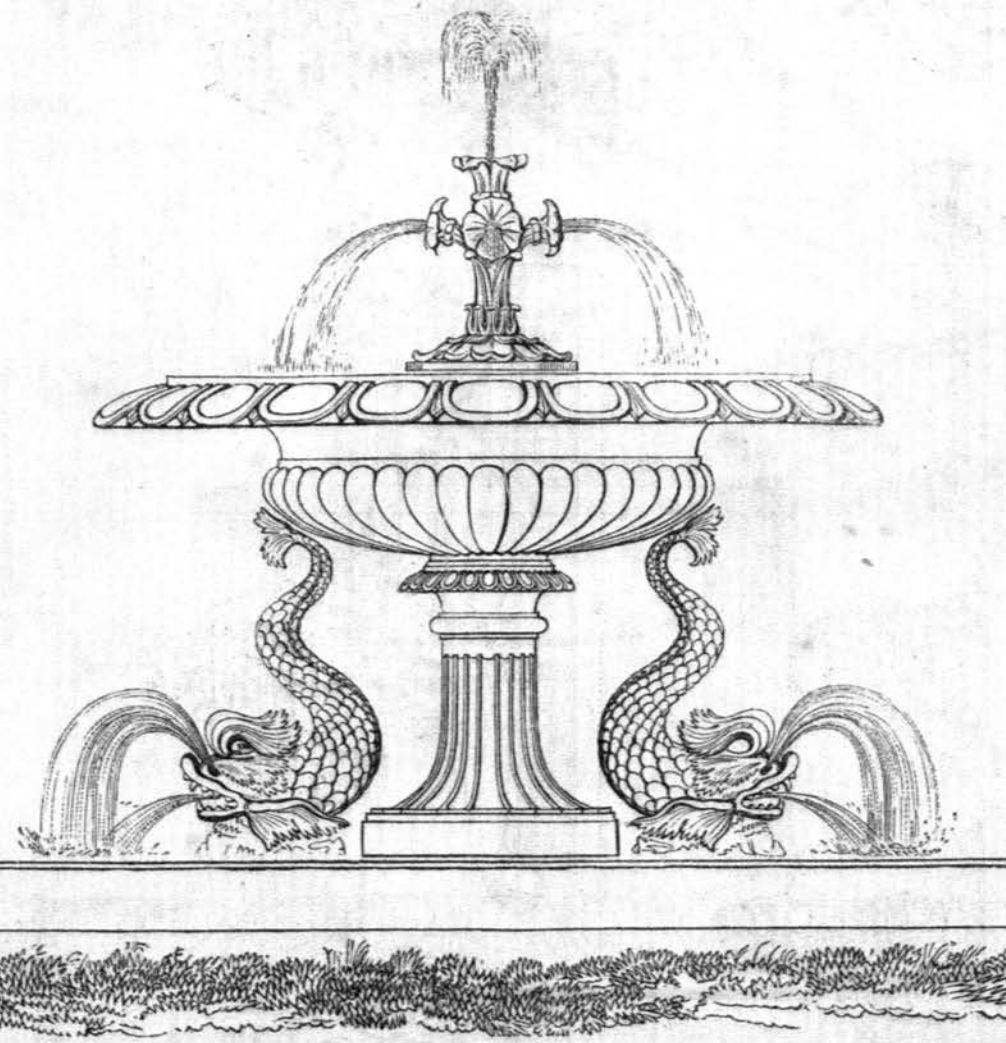
4 ft. 2 in.

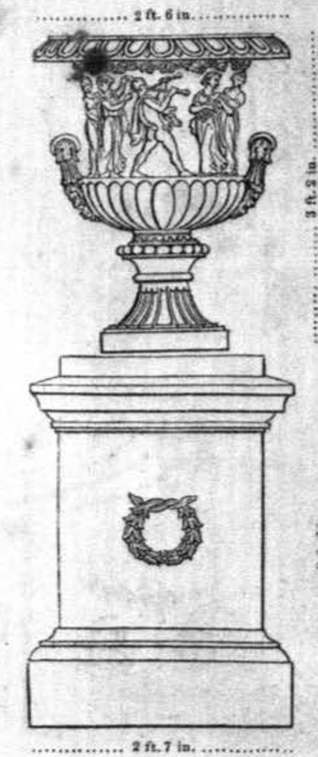
2 ft. 7 in.

Also another Model, with closed wings, 14 in. high.

A Set of Four Pigeons in different postures and other Birds, life size.

SHELL TAZZA.
GRIFFIN TRIPOD.





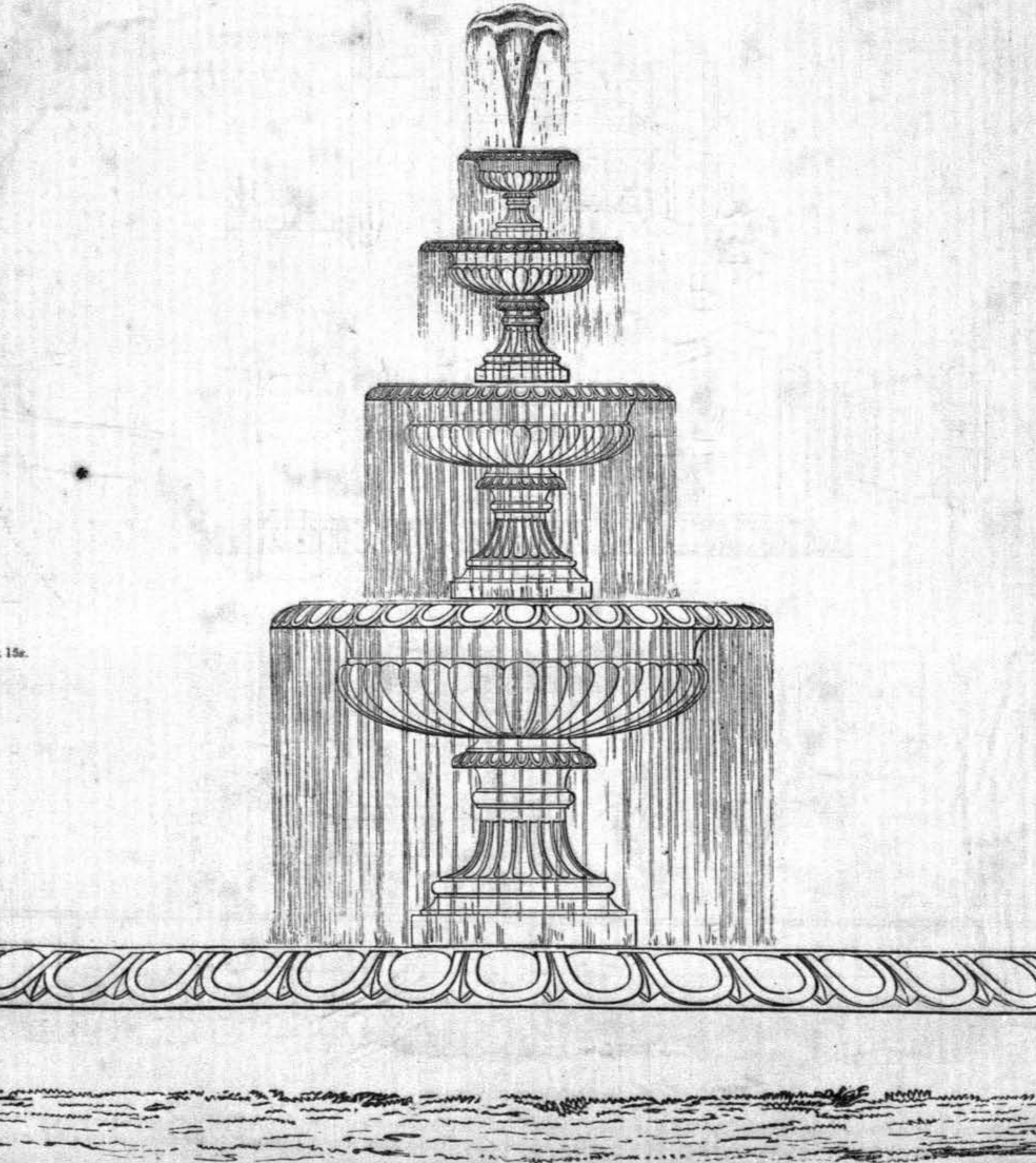
BORGHESE VASE AND BOLD MOULDED PEDESTAL
WITH WREATH.

THE SYPHON FOUNTAIN.

The Syphon Fountain is constructed upon the simple principle of natural intermitting springs; thus, the above Tazza is divided into two or more compartments, and pipes are laid from each to the several Dolphins below, the pipes being bent at the top: as soon as the compartments become quite full, and not till then, the contents will be rapidly drawn off through the Dolphins, and thus one or more of them may be seen playing, as their respective compartments become filled.

A Variety of Shells, from 25s. to £15 : 15s.

Antique Vase and Pedestal.



Set of Four Grecian Tazzas; lower one, 6 feet diameter, and lower Basin, with Enriched Rim, 20 feet diameter.